ZooKeys 1201: 255–343 (2024)
DOI: 10.3897/zookeys.1201.115467

Monograph

Checklist of hosts, illustrated geographical range, and ecology of tick species from the genus *Ixodes* (Acari, Ixodidae) in Russia and other post-Soviet countries

Denis Fedorov[1,2], Sándor Hornok[1,3]

1 *HUN-REN-UVMB Climate Change: New Blood-sucking Parasites and Vector-borne Pathogens Research Group, Budapest, Hungary*
2 *Zoological Institute of the Russian Academy of Sciences (ZIN-RAS), St. Petersburg, Russia*
3 *Department of Parasitology and Zoology, University of Veterinary Medicine, Budapest, Hungary*

Corresponding author: Denis Fedorov (denis.fedorov@univet.hu)

Abstract

Hard ticks (Acari: Ixodidae) are the economically and ecologically most important blood-sucking arthropod vectors that can transmit disease agents under temperate climate. In this group, the highest number of species (currently nearing 270) belongs to the genus *Ixodes*. For this review, more than 400 papers related to this genus in the context of Russia were checked for data on the host records, locations of collection, as well as ecology of assigned tick species. This monograph compensates for the lack of a similarly comprehensive English-language overview of *Ixodes* species in the region of Russia for nearly half century, and also makes a large set of data easily available for international readers, which is especially important if the original source is difficult to access from outside this country. In addition, the data from a significant number of papers on this topic available only in the Russian language are made accessible through this work.

Key words: Acari, Aves, Ixodidae, Mammalia, Reptilia, subgenus, taxonomy

OPEN ACCESS

Academic editor: Dmitry Apanaskevich
Received: 8 November 2023
Accepted: 5 March 2024
Published: 14 May 2024

ZooBank: https://zoobank.org/8D1CCA9B-7B9C-45CC-A21C-66F406ACBF6C

Citation: Fedorov D, Hornok S (2024) Checklist of hosts, illustrated geographical range, and ecology of tick species from the genus *Ixodes* (Acari, Ixodidae) in Russia and other post-Soviet countries. ZooKeys 1201: 255–343. https://doi.org/10.3897/zookeys.1201.115467

Copyright: © Denis Fedorov & Sándor Hornok. This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0).

Introduction

Russia is the largest country of the globe, covering nearly one third of the territory of Eurasia and 1/8th of the entire Earth's landmass. It belongs to the Palearctic Zoogeographic Region (Guglielmone et al. 2023). The ecosystems of Russia are very diverse, including polar deserts, tundra, forest tundra, taiga, mixed and broad-leaved forests, forest steppe, steppe, semi-desert, and subtropics. At least 1100 species of terrestrial vertebrates are known to occur in this country, of which 65% of the territory is considered virtually untouched by economic and other human activities (CBD 2023).

With such a vast area, the broad spectrum of suitable habitats and vertebrate hosts in the background, the tick fauna of Russia was extensively studied. Although there was an enormous collection of data published in English (Anastos 1957), because it is more than half a century old, it is outdated. Moreover, the most well-known source describing the taxonomic diversity of Ixodidae Koch in this country and its nearby regions was compiled decades ago (Filippova 1977;

1997), and is only available in the Russian language. This book on ixodid species in Russia included 34 *Ixodes* Latreille species, which is updated to 37 by adding species with more recent data, as exemplified by *Ixodes prokopjevi* Emelyanova and *I. ghilarovi* Filippova & Panova, as well as *I. turdus* Nakatsudi with its first and single record (Bolotin and Kolonin 1979). Recent work has also been published including a list of hard tick species known to be indigenous in Russia (Guglielmone et al. 2023) with indications of tick species of other post-Soviet countries. However, the latter does not consider their specific locations or host records and various distinctive features of biology relevant to certain regions. Less studied species (some often known exclusively from these territories by single or a limited number of findings) are also reviewed here in more detail, in particular with the addition of precise data on their type specimens.

The need was recognized for a comprehensive work that would contain data and references from the last decades, written in English, which would thus be accessible by experts and anyone interested in the current ixodid fauna and its supportive hosts in the vast geographical and biotope range of Russia, as well as several other post-Soviet territories. In this review the authors tried to compensate for this scarcity of fresh information on hard ticks occurring in Russia and former states of the Soviet Union, targeting the most species-rich genus, *Ixodes*. Although the checklist and georeferenced data might still contain gaps, this work is also intended to be used as baseline data for the unfolding quest to discover and to describe not-yet-known ixodid species in this extensive geographical range.

Materials and methods

The relevance of publications used in this review was searched in databases using the keywords of *Ixodes* species, their hosts, and locality or region. The following databases were used: Library of the Russian Academy of Sciences (including its department at the Zoological Institute of the Russian Academy of Sciences), Springer Link, Web of Science, Zoological Record, Google Scholar, and CyberLeninka – the Russian scientific electronic library. However, a limited number of works was excluded from consideration and inclusion in the review due to the absence of scientific background and/or indeterminate data. Similarly, papers with repetitive data (i.e., not adding new tick-host associations, geographical locations to existing literature data) are not cited.

The same databases were used for searching and estimating the data on *Ixodes* from the post-Soviet territories, reviewed in this checklist: Russia, Belarus, Ukraine, Moldova, Georgia, Azerbaijan, Armenia, Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan, and Tajikistan. The Baltic states (Estonia, Latvia, and Lithuania) were excluded from the consideration due to the availability of recently updated tick checklists, as well as the well-studied tick fauna (Paulauskas et al. 2010; Kitrytė and Baltrūnaitė 2023), which is also very similar to the tick fauna of neighboring Belarus and northwestern Russia.

Within Prostriata (genus *Ixodes*), tick species names are arranged according to their subgenera and are used sensu Guglielmone et al. (2014). The Latin names of tick species are written according to Guglielmone et al. (2023). The only exception is *Ixodes filippovae* Černý which we consider a synonym of *Ixodes crenulatus* Koch according to Filippova (1958a, 1977). The names of host species are written in accordance with their international English names, as well as the current

Latin names using the online databases, such as ASM Mammal Diversity Database (https://www.mammaldiversity.org/index.html) as well as Avibase (https://avibase.bsc-eoc.org/) and Reptile Database (http://www.reptile-database.org/).

Systematics

Class Arachnida
Order Ixodida
Family Ixodidae Koch, 1844
Genus *Ixodes* Latreille, 1795
Subgenus *Ceratixodes* Neumann, 1902: 115

***Ixodes uriae* White, 1852**

Ixodes uriae White, 1852: 208.
Ixodes jacksoni Hoogstraal, 1967: 37.
Ixodes fimbriatus Kramer & Neumann, 1883: 527; Neumann 1911: 29.
Ixodes borealis Kramer & Neumann, 1883: 526; Neumann 1911: 29.
Ixodes hirsutus Birula, 1895: 353; Arthur 1963: 152.
Ixodes putus (Pickard-Cambridge, 1876): 260; Neumann 1899: 125; Schulze 1938: 12.
Ixodes putus procellariae Schulze, 1930: 123; Zumpt 1952: 12.

Recorded hosts. Aves: auks - birds of the family Alcidae, namely: *Alca torda* Linnaeus (razorbill), *Cepphus grylle* Linnaeus (black guillemot), *Fratercula arctica* Linnaeus (common puffin), *Uria aalge* (Pontoppidan) (common guillemot), *Uria lomvia* Linnaeus (Brünnich's guillemot) (Filippova 1977).

Occasional hosts include *Fratercula cirrhata* (Pallas) (tufted puffin) and also various species of gulls and kittiwakes (Laridae): *Rissa brevirostris* (Bruch) (red-legged kittiwake), *R. tridactyla* (Linnaeus) (black-legged kittiwake) (Karpovich 1970; Dietrich et al. 2012), as well as fulmars (Procellariidae) – *Fulmarus glacialis* Linnaeus (northern fulmar) and cormorants (Phalacrocoracidae) – *Phalacrocorax capillatus* (Temminck and Schlegel) (Japanese cormorant), *Urile pelagicus* (Pallas) (pelagic cormorant), *Urile urile* (Gmelin) (red-faced cormorant) (Lvov et al. 1972b, 1975; Filippova 1977; Dietrich et al. 2012; Duron et al. 2014). A single atypical case of parasitism on *Motacilla alba* Linnaeus (white wagtail) (Motacillidae) was also reported (Karpovich 1970).

Recorded locations (Fig. 1). Murmansk seacoast (Russia): islands and seashores of the White Sea and also the Barents Sea (Karpovich 1971), namely: the Kuvshin Island and Kharlov Island (Karpovich 1970), Podpakhta Bay (Beklesheva et al. 1970), Dvorovaya Bay (Flint and Kostryko 1967), Seven Islands Reserve (Belopolskaya 1952; Karpovich 1973). **The Far East (Russia):** Mosolova Bay (the northern coast of the Strait of Tartary) (Savitskaya 1975), Bering Island (Lvov et al. 1975; Dietrich et al. 2012), Ptichy Island and Starichkov Island (Dietrich et al. 2012), Iony Island (Lvov et al. 1975), Kuril Islands (Lvov et al. 1975; Dietrich et al. 2012), Tyuleniy Island (Karpovich 1971; Lvov et al. 1972a; Filippova 1977), Sakhalin (Lvov et al. 1972a), Commander Islands (Dietrich et al. 2012).

Ecology and other information. *Ixodes uriae* is the only representative of the subgenus *Ceratixodes* in the tick fauna of Russia and the northern hemisphere

Figure 1. Map of Russia and neighboring countries showing the locations where *Ixodes uriae* was reported.

in general. As a nidicolous parasite of seabirds living in colonies, it is a species with a circumpolar distribution, occurring on oceanic coasts and islands of both the northern and southern hemispheres, from the polar regions to the subtropical zone (Wilson 1967; Filippova 1977).

In the northern hemisphere, this tick species is strongly associated with seabirds of the family Alcidae. The high degree of nest conservativity of these birds contributes to supporting a considerable number of ticks in bird colonies, which use the same places for many years (Karpovich 1971). The occasional hosts of *I. uriae* usually become involved in its life cycle in mixed bird colonies, where nests of typical and atypical hosts are located very close to each other (Violovich 1962b). In absence of auks, it may also use, for example, cormorants as exclusive hosts, as reported on the Kuril Islands (Lvov et al. 1975; Dietrich et al. 2012). In the southern hemisphere it was noted that penguins (Spheniscidae) are more typical hosts; this can be explained by similarities in the habits of these birds to those of puffins and guillemots.

There were noted rare records of adults from Carnivora: Mustelidae, and nymphs from Rodentia: Muridae (Eley 1977; Jaenson and Jensen 2007; Baggs et al. 2011; Guglielmone et al. 2020) and even humans (Karpovich 1971; Keirans and Lacombe 1998; Martyn 1998; Smith et al. 2006; Jaenson and Jensen 2007).

Subgenus *Eschatocephalus* Frauenfeld, 1853: 55

Ixodes simplex Neumann, 1906

Ixodes simplex Neumann, 1906: 197.
Ixodes audyi Kohls, 1955: 1; Clifford et al. 1973: 489.
Ixodes spiculae Arthur, 1956: 180.
Ixodes pospelovae Emchuk, 1955: 606; Beaucournu 1966: 495.
Ixodes chiropterorum Babos & Janisch, 1958: 389; Beaucournu 1966: 495.

Figure 2. Map of Russia and neighboring countries showing the locations where *Ixodes simplex* was reported.

Recorded hosts. Mammalia: *Myotis blythii* Tomes (lesser mouse-eared bat), *Miniopterus schreibersii* (Kuhl) (common bent-wing bat), *Nyctalus leisleri* (Kuhl) (lesser noctule) (Filippova 1977).

Recorded locations (Fig. 2). Russia: Krasnodar Krai – outskirts of Sochi (Emchuk 1955; Filippova 1972). **Ukraine:** eastern Carpathians – outskirts of Solotvyn and Rakhiv (Emchuk 1955; Filippova 1972). **Azerbaijan:** outskirts of Şahbuz and Hadrut (Emchuk 1955; Filippova 1972).

Ecology and other information. *Ixodes simplex* is a tick species specialized for bats as hosts (Filippova 1977). This species is mainly monoxenous and can be found usually on the common bent-wing bat although some other species of the Chiroptera may also act as hosts, especially which share colonies with its main host (Beaucournu 1967). Some rare cases of human infestation are also recorded (Okino et al. 2010; Péter et al. 2021).

Ixodes vespertilionis Koch, 1844

Ixodes vespertilionis Koch, 1844b: 232.
Ixodes longipes Lucas: Neumann 1901: 249.
Ixodes pagurus Neumann, 1911: 28.
Ixodes nodulipes (Kolenati): Neumann 1911: 28.
Ixodes troglodytes Schmidt in Frauenfeld: Neumann 1901: 249.
Eschatocephalus gracilipes Frauenfeld: Estrada-Peña 1989: 165.
Eschatocephalus nodulipes Santos Dias: Santos Dias 1961: 229.
Eschatocephalus seidlitzii Koch: Neumann 1911: 30.
Eschatocephalus frauenfeldi Koch: Neumann 1901: 249.
Eschatocephalus seidlitzi Koch: Neumann 1901: 249.
Eschatocephalus vespertilionis (Koch): Neumann 1901: 249.
Eschatocephalus exaratus (Kolenati): Neumann 1901: Santos Dias 1961: 229.

Eschatocephalus flavipes (Koch): Doss and Anastos 1977: 34.

Recorded hosts. Mammalia: *Eptesicus serotinus* (Schreber) (serotine bat), *Myotis blythii* (lesser mouse-eared bat) (Filippova 1977), pond bat *Myotis dasycneme* (Boie) (Starikov et al. 2017b), Daubenton's bat *Myotis daubentonii* (Kuhl) (Orlova et al. 2011), *Myotis myotis* (Borkhausen) (greater mouse-eared bat) (Filippova 1977), *Myotis mystacinus* (Kuhl) (whiskered bat) (Bobkova 2003), *Nyctalus noctula* (Schreber) (common noctule), *Pipistrellus pipistrellus* (Schreber) (common pipistrelle), *Rhinolophus ferrumequinum* (Schreber) (greater horseshoe bat), *Rhinolophus hipposideros* (Bechstein) (lesser horseshoe bat), *Rhinolophus mehelyi* Matschie (Mehely's horseshoe bat) (Filippova 1977).

Recorded locations (Fig. 3). Russia: Udmurtia (Orlova et al. 2011), Voronezh Oblast (Usmsnskyi pine forest), (Khitsova and Sherstyanykh 2014), Novosibirsk Oblast (resort Lake Karachi) (Fedorov 2016), Khanty-Mansi Autonomous Okrug (outskirts of the urban locality Mortka) (Starikov et al. 2017b), Krasnodar Krai (Sochi National Park) (Romashin 2021), Stavropol Krai (Tsapko 2019). **Ukraine:** Ivano-Frankivsk Oblast, Chernivtsi Oblast, Ternopil Oblast, Zakarpattia Oblast, Crimea (Bobkova 2003). **Moldova:** Codru Reserve (Dniester-Prut interfluve) (Uspenskaya 1987). **Georgia:** Abkhazia (Kerbabaev 2011). **Azerbaijan:** Shusha, Hadrut (Filippova 1972). **Armenia:** Meghri (Ogandzhanyan 1949). **Kyrgyzstan:** Chüy Valley (Fedorova 2012a). Turkmenistan: rural localities Ahcha-Kuima and Mollagara (Dubinin and Bregetova 1952). **Tajikistan:** northern spurs of the Zarafshan Range (Filippova 1972).

Ecology and other information. *Ixodes vespertilionis* Koch is a species of ixodid ticks associated with bats as typical hosts (Filippova 1977), mostly from the families Rhinolophidae and Vespertilionidae. Usually, *I. vespertilionis* can be found in caves inhabited by bats. Occasional findings in Central Russia and Siberia are considered to result from accidental transportation.

Figure 3. Map of Russia and neighboring countries showing the locations where *Ixodes vespertilionis* was reported.

Subgenus *Filippoviella* Apanaskevich, Greiman & Fedorov, 2024: 229

***Ixodes ghilarovi* Filippova & Panova, 1988**

Ixodes ghilarovi Filippova & Panova, 1988: 212.

Recorded hosts. Mammalia: *Apodemus flavicollis* Melchior (yellow-necked field mouse), *Chionomys gud* Satunin (Caucasian snow vole), *Chionomys nivalis* (Martins) (European snow vole), *Microtus daghestanicus* (Shidlovsky) (Daghestan pine vole), *Nothocricetulus migratorius* (Pallas) (grey dwarf hamster), *Sorex raddei* Satunin (Radde's shrew) (Filippova and Panova 1989; Filippova and Stekol'nikov 2007).

Recorded locations (Fig. 4). Russia: Dagestan – the valley of the Akhtychay River which is the right tributary of the Samur River near the confluence of these rivers, ~ 1000 m a.s.l. and at the same location near rural locality Khnov, ~ 1700 m a.s.l.; the valley of the Avar Koysu River, ~ 1000 m a.s.l. (Filippova and Panova 1989); Kabardino-Balkaria, Bezengi gorge – 1550–2500 m a.s.l. and Karachay-Cherkessia – 1900–2200 m a.s.l. (Filippova and Stekol'nikov 2007). **Georgia:** Mtskheta-Mtianeti region, Kazbegi Municipality, outskirts of the hamlet Suatisi, 2200 m a.s.l. (Filippova and Panova 1989).

Ecology and other information. *Ixodes ghilarovi* is the second representative of the subgenus *Filippoviella* in the Palearctic tick fauna together with *I. trianguliceps* but known at the current moment exclusively from several locations of the Caucasus (Filippova and Panova 1988). The species was found only in rocky biotopes on the slopes containing xerophilous herbaceous-shrub vegetation consisting of many endemics of Southern Dagestan (Filippova and Panova 1989).

Further investigations of this poorly studied tick species are of undoubted interest. *Ixodes ghilarovi* has certain common structural features with the African

Figure 4. Map of Russia and neighboring countries showing the locations where *Ixodes ghilarovi* was reported.

species *I. alluaudi*, for example the presence of auriculae, especially visible in nymphs of both species (Filippova 2010); molecular analysis is also necessary to obtain more data on interspecific connections of these ticks and inside the subgenus in general. The host-parasite relations of *I. ghilarovi* and its distribution and habitats are probably wider than it is known today. The seasonality of *I. ghilarovi* and its role as a vector of tick-borne infections remain unknown.

The type specimens of *I. ghilarovi* are deposited at the Zoological Institute of the Russian Academy of Sciences and include the holotype: nymph; Russia, 25, Daghestan, Samur Mt. Range, near Akhty Village, River Akhtychay valley, ~ 1000 m a. s. l., *Chionomys gud*, Sat., 24.5.1980, coll. I.V. Panova; FBM 610a, 610b and the paratypes: 4 nymphs; FBM I610a, I610b. Description – Filippova and Panova 1989: 419–421 (female, larva; male unknown) (Filippova 2008).

***Ixodes trianguliceps* Birula, 1895**

Ixodes trianguliceps Birula, 1895: 358.
Ixodes nivalis Rondelli, 1928: 85; Pomerantsev 1950: 84.
Ixodes tenuirostris Neumann, 1901: 286.
Endopalpiger heroldi Schulze, 1939: 35; Černý 1959: 156.

Recorded hosts. Mammalia: *Alexandromys oeconomus* (Pallas) (tundra vole), *Apodemus agrarius* (Pallas) (striped field mouse) (dominates as the host in the Udel'ny forest park in St. Petersburg, according to Tretyakov (2009), *Apodemus flavicollis* (yellow-necked field mouse), *Apodemus sylvaticus* (Linnaeus) (wood mouse), *Apodemus uralensis* Pallas (Ural field mouse), *Arvicola amphibius* (Linnaeus) (European water vole), *Chionomys gud* (Caucasian snow vole), *Chionomys nivalis* (European snow vole), *Craseomys rufocanus* (Sundevall) (grey red-backed vole), *Cricetus cricetus* (Linnaeus) (European hamster), *Crocidura leucodon* (Hermann) (bicolored shrew), *Crocidura suaveolens* (Pallas) (lesser white-toothed shrew), *Eutamias sibiricus* (Laxmann) (Siberian chipmunk), *Lasiopodomys gregalis* (Pallas) (narrow-headed vole), *Lepus europaeus* Pallas (European hare), *Lepus timidus* Linnaeus (mountain hare), *Micromys minutus* (Pallas) (harvest mouse), *Microtus agrestris* (Linnaeus) (short-tailed field vole), *Microtus arvalis* (Pallas) (common vole), *Microtus majori* (Thomas) (Major's pine vole), *Microtus socialis* (Pallas) (social vole), *Microtus subterraneus* (de Selys-Longchamps) (European pine vole), *Mus musculus* Linnaeus (house mouse), *Mustela nivalis* Linnaeus (least weasel), *Myodes glareolus* (Schreber) (bank vole), *Myodes rutilus* (Pallas) (northern red-backed vole), *Myopus schisticolor* (Lilljeborg) (wood lemming), *Neomys anomalus* Cabrera (Mediterranean water shrew) (Filippova 1977), *Neomys fodiens* (Pennant) (Eurasian water shrew) (Lutta 1968), *Nyctalus noctula* (common noctule), *Ochotona alpina* (Pallas) (alpine pika), *Prometheomys schaposchnikowi* Satunin (long-clawed mole vole), *Rattus norvegicus* (Berkenhout) (brown rat), *Sciurus vulgaris* Linnaeus (red squirrel), *Sicista betulina* Pallas (northern birch mouse), *Sorex araneus* Linnaeus (common shrew), *Sorex caecutiens* Laxmann (Laxmann's shrew), *Sorex daphaenodon* Thomas (Siberian large-toothed shrew) (Filippova 1977), *Sorex isodon* Turov (taiga shrew) (Sapegina 1980), *Sorex minutus* Linnaeus (Eurasian pygmy shrew), *Sorex minutissimus* Zimmermann (Eurasian least shrew) (Filippova 1977), *Sorex roboratus* Hollister (flat-skulled shrew)

(Shtilmark 1963; Sapegina 1980), *Spermophilus suslicus* (Güldenstädt) (speckled ground squirrel), *Vulpes vulpes* (Linnaeus) (red fox) (Filippova 1977).

Aves: *Anthus trivialis* (Linnaeus) (tree pipit), *Carduelis carduelis* (Linnaeus) (European goldfinch), *Dendrocopos major* (Linnaeus) (great spotted woodpecker), *Emberiza citronella* Linnaeus (yellowhammer), *Nucifraga caryocatactes* (Linnaeus) (Eurasian nutcracker), *Strix uralensis* Pallas (Ural owl), *Turdus viscivorus* Linnaeus (mistle thrush) (Filippova 1977).

Reptilia: *Zootoca vivipara* (viviparous lizard) (Lichtenstein) (Filippova 1977).

Recorded locations (Fig. 5). Russia: North Karelia – Cape Kartesh (Stanyukovich and Fedorov 2022); Karelia (Lutta 1968) including the village Malaya Gomselga (southern Karelia) (Bespyatova and Bugmyrin 2015; Bespyatova et al. 2019), St. Petersburg (Tretyakov 2009), Leningrad Oblast (Sukhomlinova 1977), Novgorod Oblast (Grigoryeva and Tretyakov 1998), Pskov Oblast – the village Gogolevo (own data, unpublished), Kaliningrad Oblast, the Vistula Spit (own data, unpublished); Tver Oblast (Schipanov and Makhanko 2018), Tula Oblast (Kozlova et al. 2014), Perm Oblast (Korenberg et al. 2015), Eastern Upper Volga (Egorov et al. 2016), Krasnodar Krai and the Caucasus (Shatas 1957; Filippova and Stekol'nikov 2007), Kurgan Oblast (Starikov and Starikova 2021), Tyumen Oblast (Bragina et al. 2013), Omsk Oblast (Rar et al. 2014, 2020), Kemerovo Oblast (Kovalevsky et al. 2018), Western Sayan (Shtilmark 1963), Eastern Sayan (Schluger 1961), Khamar-Daban ridge (Vershinina 1988). **Belarus** (Arzamasov 1963). **Ukraine:** Crimea (Filippova 2010), Polesia (Podobivskyi and Fedonyuk 2017). **Moldova:** north and central Moldova (Uspenskaya et al. 2006). **Georgia:** the village Bakuriani and the Roki Tunnel (Djaparidze 1960). **Armenia:** the whole territory (Ogandzhanyan 1960). **Azerbaijan:** the south of the country (Ogandzhanyan 1960).

Ecology and other information. *Ixodes trianguliceps* Birula has a wide geographical distribution in the Palaearctic region, occurring from the coast of Lake

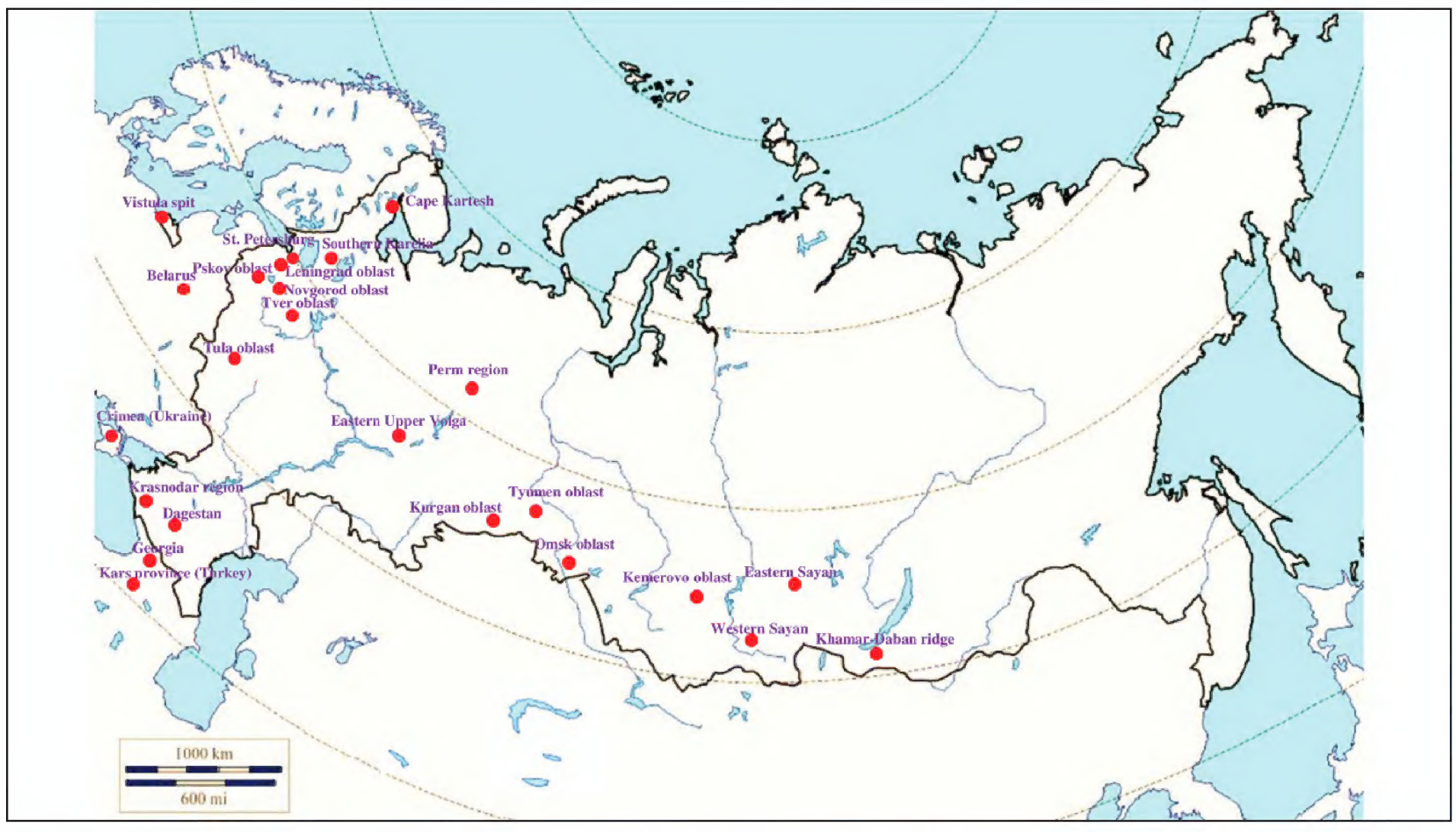

Figure 5. Map of Russia and neighboring countries showing the locations where *Ixodes trianguliceps* was reported.

Baikal to Western Europe (Filippova 2010; Estrada-Peña et al. 2018). In the north it reaches northern Karelia and the Scandinavian Peninsula (Fedorov and Leonovich 2021). Also, an isolated southern population of this species was found in the Crimean Peninsula (Filippova 2010) although in other parts of Ukraine it is present in forest zones, such as Polesia (Podobivskyi and Fedonyuk 2017).

The population that was supposed to be isolated in the mountain systems of the Caucasus (Filippova 2010) now seems to be more expanded, as proved by the recent finding in Turkey (Bolu and Kars province, the north of Turkey) (Keskin and Selçuk 2021). The Kars province is located near the border with Georgia, where this species was known before (Djaparidze 1960) and, therefore, the ticks reported from there are probably part of the same Caucasian population.

The map of findings of this tick species in Russia clearly illustrates that it lives in a broad range of forest biotopes throughout a vast territory including the zonal and mountain deciduous and mixed forest of the European type and forests of southern and middle-taiga types. Along the southern border of the largest part of the range in Russia, *I. trianguliceps* occurs in the forest-steppe zone, populating shrubby and forested biotopes. This distinctly correlates with the main habitats of shrews and rodents, because the presence of these small mammals together with well-developed soil litter, plays an important role in the abundance of ticks in the landscape, as it is known that shrews of the genus *Sorex* are the most preferable host for larvae (Randolph 1975).

Interestingly, *I. triangulipeps* was also reported from two bat species (*Myotis myotis* in Poland (Siuda et al. 2009) and *Nyctalus noctula* in Russia, as well as several bird species and one reptile species (Filippova 1977). These animals are non-typical and occasional hosts for this tick species. The single cases of parasitism on these host species can be a clear indication that *I. trianguliceps* is predominantly an exophilic species, because it is unlikely that ticks could contact bats and birds in a burrow. Findings of this tick species in micropores of burrow tunnels in Belarus in winter (Arzamasov 1963) demonstrate only the ability of its larvae to remain active even during winter.

Phylogenetic trees inferred from the concatenated nucleotide sequences of 10 protein-coding genes of the mitochondrial genome of *I. trianguliceps*, together with consideration of its morphology, justified to establish the new subgenus *Filippoviella* and include there *I. trianguliceps* together with aforementioned *I. ghilarovi* (Apanaskevich et al. 2024) both of which used to belong to the subgenus *Exopalpiger*.

Subgenus *Ixodes* Latreille, 1795: 179

Ixodes apronophorus Schulze, 1924

Ixodes apronophorus Schulze, 1924: 281.
Ixodes arvicolae Warburton, 1926: 55; Morel and Pérez 1978: 201.
Ixodes arvalis Karpov & Popov, 1944: 75; Morel and Pérez 1978: 201.
Ixodes dorrien-smilhi Turk: Morel and Pérez 1978: 201.
Ixodes dorriensmithi Turk: Morel and Pérez 1978: 201.

Recorded hosts. Mammalia: *Alexandromys oeconomus* (tundra vole), *Apodemus agrarius* (striped field mouse), *Apodemus flavicollis* (yellow-necked field mouse),

Apodemus sylvaticus (wood mouse), *Arvicola amphibius* (European water vole), *Cricetus cricetus* (European hamster), *Craseomys rufocanus* (grey red-backed vole), *Erinaceus europaeus* Linnaeus (European hedgehog), *Eutamias sibiricus* (Siberian chipmunk), *Lasiopodomys gregalis* (narrow-headed vole), *Lepus timidus* (mountain hare), *Micromys minutus* (Eurasian harvest mouse), *Microtus arvalis* (common vole), *Microtus agrestis* (Linnaeus) (short-tailed field vole), *Mus musculus* (house mouse), *Mustela nivalis* (least weasel), *Mustela sibirica* Pallas (Siberian weasel), *Myodes glareolus* (bank vole), *Myodes rutilus* (northern red-backed vole), *Myopus schisticolor* (wood lemming), *Neomys fodiens* (Eurasian water shrew), *Nothocricetulus migratorius* (grey dwarf hamster), *Ondatra zibethicus* (Linnaeus) (muskrat), *Rattus rattus* (Linnaeus) (black rat), *Sicista betulina* (northern birch mouse), *Sorex araneus* (common shrew), *Sorex caecutiens* (Laxmann's shrew), *Sorex daphaenodon* (Siberian large-toothed shrew), *Sorex isodon* (taiga shrew), *Sorex minutus* (Eurasian pygmy shrew), *Sorex roboratus* (flat-skulled shrew), *Talpa europaea* Linnaeus (European mole), *Vulpes vulpes* (red fox) (Filippova 1977).

Aves: *Anas crecca* Linnaeus (Eurasian teal) (Adamovich 1968), *Gallinula chloropus* (Linnaeus) (common moorhen) (Filippova 1977), *Motacilla alba* (white wagtail), *Turdus merula* Linnaeus (common blackbird) (Adamovich 1968).

Recorded locations (Fig. 6). Russia: Arkhangelsk Oblast (Olenev 1931a), Karelia (Lutta 1976), Saint-Petersburg (Tretyakov 2009), Leningrad Oblast (Sukhomlinova 1977), Vologda Oblast, Tver Oblast (Filippova 1977; Belova et al. 2008), Moscow Oblast (Mosolov 1961), the whole territory of the Upper-Volga (Egorov et al. 2016), Samara Oblast (Kirillova and Kirillov 2008a), Bryansk Oblast (Adamovich 1968), Voronezh Oblast, Nyzhny Novgorod Oblast (Solovyov 1966), Chuvash Republic (Petrov et al. 1967), Krasnodar Krai (Kalita and Pelipeychenko 1957; Shevchenko et al. 1960), Kabardino-Balkaria (Bittirova et al. 2019), Dagestan (Aliev et al. 2012), Perm Krai, Chelyabinsk Oblast (Filippova 1958a),

Figure 6. Map of Russia and neighboring countries showing the locations where *Ixodes apronophorus* was reported.

Ekaterinburg (Chernousova and Tolkachyov 2009), Omsk Oblast (Znamenskiy district and Bolsheukov district) (Sabitova et al. 2023), Khanty-Mansiysk (Popov 1967), Surgut (Petukhov et al. 2018), Novosibirsk Oblast (Novosibirsk and Toguchinsky District) (Mal'kova and Bogdanov 2004), Tyumen Oblast – Nyzhnevartovsk (Starikov et al. 2017a), Kurgan Oblast (Starikov and Starikova 2021), Salekhard (Starikov et al. 2017a), Tomsk Oblast (Chainsky District) (Mal'kova and Bogdanov 2004), Kemerovo Oblast, Altai Krai, Altai Republic (Bogdanov and Yakimenko 2016), Krasnoyarsk Krai – Podkamennaya Tunguska River and the rural locality Bolshoy Kemchug (Voltsyt 1997). **Ukraine:** Volyn Polesie (Adamovich 1968), outskirts of Kyiv (Akimov and Nebogatkin 2013), Cherkassy Oblast (Nikitchenko 2011), the North-Western seacoast of the Black Sea (Rusev 2009). **Belarus:** throughout the whole territory (Subbotina and Osmolovsky 2022). **Moldova:** reedbeds of the lower reaches of the Prut River (Uspenskaya et al. 1984). **Kazakhstan:** Jambyl Region (Galuzo 1950), Jetisu Region – outskirts of Taldykorgan and Jarkent, Almaty Region – outskirts of Sarkand and Almaty (Golov 1933; Sorokoumov 1937; Ushakova and Fedosenko 1972; Ushakova et al. 1976). **Kyrgyastan:** outskirts of Bishkek, Tokmak Reserve (Grebenyuk 1966), Chuy Valley (Kharadov et al. 2013).

Ecology and other information. *Ixodes apronophorus* has a wide distribution in the Northern Palearctic from the Atlantic coast to Eastern Siberia. Its geographical range generally coincides with the distribution of the water vole, its most frequent host, as both the tick and its common host prefer swampy and humid places for living, especially near water bodies.

Ixodes eldaricus Djaparidze, 1950

Ixodes eldaricus Dzhaparidze, 1950: 117.
Ixodes tatei Arthur, 1959: 108; Clifford et al. 1973: 489.

Recorded hosts. Aves: *Alectoris chukar* (Gray) (chukar partridge), *Anthus campestris* (Linnaeus) (tawny pipit), *Athene noctua* (Scopoli) (little owl), *Chroicocephalus ridibundus* (Linnaeus) (black-headed gull), *Coccothraustes coccothraustes* (Linnaeus) (hawfinch), *Coloeus monedula* (Linnaeus) (western jackdaw), *Curruca communis* (Latham) (common whitethroat), *Emberiza bruniceps* Brandt (red-headed bunting), *Galerida cristata* (Linnaeus) (crested lark), *Lullula arborea* (Linnaeus) (woodlark), *Luscinia svecica* (Linnaeus) (bluethroat), *Melanocorypha bimaculata* (Ménétrés) (bimaculated lark), *Monticola solitarius* (Linnaeus) (blue rock thrush), *Oenanthe* sp. (wheatear), *Passer domesticus* (Linnaeus) (house sparrow), *Perdix perdix* (grey partridge), *Petronia petronia* (Linnaeus) (rock sparrow), *Phoenicurus erythronotus* (Eversmann) (Eversmann's redstart), *Phylloscopus griseolus* (Blyth) (sulphur-bellied warbler), *Pica pica* (Linnaeus) (Eurasian magpie), *Sitta tephronota* Sharpe (Eastern rock nuthatch), *Turdus merula* (common blackbird) (Filippova 1977).

Mammalia: *Crocidura leucodon* (bicolored shrew), *Meriones persicus* (Blanford) (Persian jird), *Mus musculus* (house mouse), *Nesokia indica* (Gray) (short-tailed bandicoot rat), grey dwarf hamster *Nothocricetulus migratorius* (Pallas), *Rattus pyctoris* (Hodgson) (Turkestan rat), *Rhinolophus mehelyi* (Mehely's horseshoe bat) (Filippova 1977).

Recorded locations (Fig. 7). Russia: Dagestan and North Osetia-Alania (Shatas 1957; Filippova 1977). **Ukraine:** Crimean Peninsula, in particular the Tarkhankut Peninsula and the Kara Dag (Filippova 1974). **Georgia:** the Shiraki Plain and the Vashlovani Nature Reserve (Djaparidze 1950, 1960). **Armenia:** Vayots Dzor Province – the rural locality Herher (Ogandzhanyan 1959). **Azerbaijan:** Karabakh Plateau – Lachin District and Hadrut District, Adzhynokhur Steppe (Ogandzhanyan 1959; Filippova 1977). **Kazakhstan:** Dzungarian Alatau (Ushakova et al. 1976) and Trans-Ili Alatau (Filippova 1977). **Kyrgyzstan:** Terskey Ala-too Range (Filippova 1974). **Turkmenistan:** the Kopet Dagh – the valley of the Chandyr River, Magtymguly, Gökdepe District, outskirts of Ashgabad, Köytendag Range, Bayramaly (Kerbabaev 1960; Kochkareva et al. 1971; Berdyev 1973; Scherbinina 1973). **Uzbekistan:** Termez (Filippova 1977). **Tajikistan:** Hisar Range, Varzob gorge, outskirts of Dushanbe (Filippova 1977).

Ecology and other information. *Ixodes eldaricus* is a little studied endophilic tick species which is mainly a parasite of ground-feeding birds although nymphs and larvae, besides birds, were also found on small mammals – rodents and shrews. It usually inhabits deciduous mountain forests and shrub thickets in mountain river valleys. The vertical distribution range of its occurrence varies from 300 (Ashgabat) to 1800 m (Terskey Ala-too Range and Hisar Range) a. s. l. (Filippova 1977).

Briefly described by a female from the east of Georgia (type locality: the Shiraki Plain), *I. eldaricus* was later found in Armenia and Azerbaijan, and the male, nymph descriptions were based on the material from Azerbaijan (Ogandzhanyan 1959). The holotype female described from the grey partridge is stored at the Institute of Zoology of Ilia State University. The above findings from post-Soviet territories are known from the Crimea, as well as the Causasus and Central Asia. The majority of samples are stored at the collection of the Zoological Institute of the Russian Academy of Sciences.

Figure 7. Map of Russia and neighboring countries showing the locations where *Ixodes eldaricus* was reported.

Additionally, it is important to note that in Crimea this tick species is considered disappearing (Nebogatkin 1998) due to anthropogenic pressure followed by destruction of its habitats and decline in its host populations (Uspensky 2021).

Ixodes kashmiricus Pomerantsev, 1948

Ixodes kaschmiricus Pomerantsev, 1948: 132; Filippova 1969: 675.
Ixodes persulcatus kaschmiricus Pomerantsev, 1948: 132; Filippova 1969: 675.

Recorded hosts. Mammalia: *Apodemus sylvaticus* (wood mouse), *Canis familiaris* Linnaeus (dog), *Ovis aries* Linnaeus (sheep) (Filippova 1977).

Recorded locations (Fig. 8). Kyrgyzstan: the Tien Shan – northern and eastern slopes of the Terskey Ala-too range (gorges Ulken-Kokpak and Chon-Dzhargylchak) (Filippova 1969).

Ecology and other information. *Ixodes kashmiricus* is a tick species with a disjunctive relict range limited by the Tien Shan in Kyrgyzstan as well as India (Filippova 1977) and Pakistan (Numan et al. 2022). In Kyrgyzstan the tick was found mainly in the mid-altitude vertical zone of the mountains at the lower border of the forest at the altitude of 2000 and 2500 m a. s. l. Cases of parasitism on humans have been recorded (Hoogstraal 1970).

Phylogenetic analysis of mitochondrial and nuclear genes showed that *I. kashmiricus* belongs to the *I. ricinus* group (Kovalev et al. 2018) and clusters with such members of the *I. ricinus* group as *I. apronophorus* and *I. kazakstani* (Numan et al. 2022).

The type specimens are stored at the Zoological Institute of the Russian Academy of Sciences and include the lectotype - female; [India], Kashmir,

Figure 8. Map of Russia and neighboring countries showing the locations where *Ixodes kashmiricus* was reported.

Vardvan Maru River, northern tributary of Chinab River, 10–13. V.1910, coll. S.P. Trubetskoi; AL I533, as well as the paralectotype - male; AL 533a. *Ixodes kashmiricus* (see: Filippova 1969: 677). Description – Filippova 1977: 292–296 (female, male, nymph, larva) (Filippova 2008). Originally the tick was named *I. persulcatus kaschmiricus* (lapsus).

Ixodes kazakstani Olenev & Sorokoumov, 1934

Recoeded hosts. Mammalia: *Apodemus sylvaticus* (wood mouse) (Filippova 1977), *Canis familiaris* (domestic dog) (Kovalev et al. 2018), *Dryomys nitedula* (Pallas) (forest dormouse), *Lepus tolai* Pallas (tolai hare), *Mus musculus* (house mouse), *Nothocricetulus migratorius* (grey dwarf hamster) (Filippova 1977).

Aves: *Phasianus colchicus* Linnaeus (common pheasant) (Filippova 1977).

Recorded locations (Fig. 9). Kazakhstan: Betpak-Dala – the valley of the Chu River (Ushakova 1961), Tian Shan – the valley of the Ili River (Ushakova 1958; Kovalev et al. 2018), outskirts of Jarkent (Olenev and Sorokoumov 1934; Pomerantsev 1950). **Kyrgyzstan:** the Issyk-Kul basin (Filippova 1958b; Kovalev et al. 2018), the valley of the Talas River (Olenev and Sorokoumov 1934; Pomerantsev 1950; Grebenyuk 1966; Lyashko 1973; Kovalev et al. 2018).

Ecology and other information. *Ixodes kazakstani* is a tick species with a disjunctive relict range limited by Southeastern Kazakhstan and neighboring territories of Kyrgyzstan (Filippova 1977). The patchy arrangement of its range can be explained, above all, by associations of this tick mainly with the animals dwelling in tugai forests which also create humidity conditions in the soil suitable for this tick species (Filippova 1958b). Also, there are some cases of parasitism on livestock and humans (Lyashko 1973; Filippova 1977). On livestock it was found in few numbers among mass parasitism of other tick species.

Figure 9. Map of Russia and neighboring countries showing the locations where *Ixodes kazakstani* was reported.

Phylogenetic analysis of mitochondrial and nuclear genes showed that *I. kazakstani* belongs to the *I. ricinus* group (Kovalev et al. 2018) and clusters with such members of the *I. ricinus* group as *I. apronophorus* and *I. kashmiricus* (Numan et al. 2022). *Ixodes kazakstani* can presumably exemplify links between Nearctic and Palearctic species, so further studies of genetic sequences of *I. kazakstani* are necessary to understand better evolutionary connections between more tick species in the *I. ricinus* group.

The type specimens are stored at the Zoological Institute of the Russian Academy of Sciences and include the holotype: female; Kazakhstan, Jarkent, collected from human dress, 20.VI.1932, coll. Kirin; AL I536. Description - Filippova 1977: 283–290 (female, male, nymph, larva) (Filippova 2008).

Ixodes laguri Olenev, 1929

Ixodes laguri Olenev, 1929a: 489.
Ixodes redikorzevi lagurae Olenev: Olenev 1931b: 62.
Ixodes laguri armeniacus Kirshenblat, 1938: 46; Morel and Pérez 1978: 201.
Ixodes laguri colchicus Pomerantsev, 1946: 1; Morel and Pérez 1978: 201.
Ixodes laguri slovacicus Cerny, 1960: 178; Morel and Pérez 1978: 201.

Recorded hosts. Mammalia: *Allactaga major* (Kerr) (great jerboa), *Allocricetulus eversmanni* (Brandt) (Eversmann's hamster), *Apodemus sylvaticus* (wood mouse), *Chionomys nivalis* (European snow vole), *Cricetus cricetus* (European hamster), *Dryomys nitedula* (forest dormouse), *Ellobius talpinus* (Pallas) (northern mole vole), *Erinaceus europaeus* (European hedgehog), *Glis glis* (Linnaeus) (European edible dormouse), *Hemiechinus auratus* (Gmelin) (long-eared hedgehog), *Lagurus lagurus* (Pallas) (steppe lemming), *Marmota bobak* (Müller) (bobak marmot), *Martes martes* (Linnaeus) (European pine marten), *Microtus arvalis* (common vole), *Microtus socialis* (social vole), *Meles meles* (Linnaeus) (European badger), *Meriones meridianus* (Pallas) (midday jird), *Mesocricetus brandti* (Pallas) (Turkish hamster), *Mesocricetus raddei* (Nehring) (Ciscaucasian hamster), *Mus musculus* (house mouse), *Mustela eversmanii* (Lesson) (steppe polecat), *Mustela nivalis* (least weasel), *Nothocricetulus migratorius* (grey dwarf hamster), *Pygeretmus pumilio* (Kerr) (dwarf fat-tailed jerboa), *Rattus rattus* (black rat), *Spalax microphthalmos* Gueldenstaedt (greater blind mole-rat), *Spermophilus citellus* (Linnaeus) (European ground squirrel), *Spermophilus fulvus* (Lichtenstein) (yellow ground squirrel), *Spermophilus pygmaeus* (Pallas) (little ground squirrel), *Spermophilus suslicus* (speckled ground squirrel), *Spermophilus xanthoprymnus* (Bennett) (Asia Minor ground squirrel), *Stylodipus telum* (Lichtenstein) (thick-tailed three-toed jerboa), *Vormela peregusna* (Güldenstädt) (marbled polecat), *Vulpes corsac* (Linnaeus) (Corsac fox), *Vulpes vulpes* (red fox) (Filippova 1977).

Recorded locations (Fig. 10). Russia: Samara Oblast (Kirillova and Kirillov 2008b), Rostov Oblast (Stakheev and Panasyuk 2016), Krasnodar Krai (Popov et al. 2019), Stavropol Krai (Tsapko 2019), Volgograd Oblast, Astrakhan Oblast (Nelzina et al. 1955), Kalmyk Republic (Sandzhiev et al. 2006), Chechnya (Baisarova 2021), Dagestan (Musaev et al. 2019) and North Osetia-Alania (Filippova 1977). **Ukraine:** Kyiv (Omeri and Moysak 2013), Odesa Oblast (Rusev 2008), Kherson Oblast, Chernivtsi Oblast, Ternopil Oblast, Luhansk Oblast, Donetsk

Figure 10. Map of Russia and neighboring countries showing the locations where *Ixodes laguri* was reported.

Oblast, the Crimean Peninsula, particularly in the Syvash (Filippova 1958a; Emchuk 1960; Sklyar 1970; Andryushchenko et al. 2005; Evstafiev 2017). **Moldova:** Bălți Steppe, Bugeac Steppe (Filippova 1977) and Tiraspol (Kravchenko 2014). **Georgia:** Abkhazia (Shaposhnikova and Sakhno 2012), Imereti (Sukhiashvili et al. 2020), Lagodekhi Nature Reserve (Djaparidze 1960). **Armenia:** Lori Province –Nalband and the valley of the river Hrazdan (Filippova 1977). **Azerbaijan:** Talysh (Pomerantsev 1950), the Nakhchivan Autonomous Republic – the Zangezur Mountains (Kadatskaya and Shirova 1963; Filippova 1977). **Kazakhstan:** West Kazakhstan Region (Pomerantsev 1950; Levit 1957; Filippova 1977), Kyzylorda Region (Loseva 1963), Kostanay Region, Akmola Region (Ushakova 1961, 1962). **Turkmenistan:** the Kopet Dagh (Kerbabaev 1961).

Ecology and other information. *Ixodes laguri* is a tick species which is mainly a nidicolous parasite of rodents and small and medium carnivores, first of all ground squirrels. It is present usually in zonal and mountainous steppes at the altitude of 1500 m a.s.l. This tick species is less common in desert and semi-desert biotopes (Filippova 1977).

Filippova (1977) states that the tick has four subspecies – *I. laguri laguri*, *I. l. armeniacus*, *I. l. colchicus* and *I. l. slovacicus*. The differential characters of the female and the male of *I. l. slovacicus* are based on comparison with characters of the other subspecies in Pomerantsev (1950) but some of them, such as the genital aperture and chaetotaxy of the scutum and the hypostome and the coxa 1, are not characterized precisely enough (Filippova 1977).

According to Filippova (1977), *I. laguri laguri* can be found in Moldova, Ukraine, Kazakhstan, as well as in the south of Russia; *I. l. armeniacus* is distributed in the Caucasus – North Osetia-Alania, Dagestan, Georgia, Armenia and Azerbaijan; *I. l. colchicus* is known from the western spurs of the Greater Caucasus, the now abandoned rural locality Babuk-Aul; *I. l. slovacicus* was described from the south-east of Slovakia.

The type specimens of *I. laguri* are deposited at the Zoological Institute of the Russian Academy of Sciences and include *I. l. armeniacus*: the lectotype, female; Armenia, Nalband, from *Mesocricetus brandti* Nehr., 9.9.1936; AL I558 and the paralectotype, male; AL I556, description – Filippova 1977: 384 (female, male, nymph; larva unknown). (Filippova 2008), as well as *I. l. colchicus*: the lectotype, male; Western Caucasus, near Babuk-Aul, *Glis glis* L., 30.9.1935, coll. V. K. Popov, det. B. Pomerantsev: *I. l. colchicus*, type; AL I554a; paralectotypes: 2 females; AL I554a, description – Filippova 1977: 384 (female, male; nymph and larva unknown) (Filippova 2008).

Ixodes nipponensis Kitaoka & Saito, 1967

Recorded hosts. Mammalia: *Apodemus agrarius* (striped field mouse), *Craseomys rufocanus* (grey red-backed vole), *Microtus fortis* (Büchner) (reed vole), *Myodes rutilus* (northern red-backed vole) (Filippova 1977).

Recorded locations (Fig. 11). Russia: Primorsky Krai – the Lake Khasan, the Poyma River, the Partizansky District, outskirts of urban localities Posyet, Kraskino, Slavyanka and cities Vladivostok and Nakhodka, near the village Rechitsa (Filippova 1969; Filippova and Belyaev 1970; Allenov et al. 2015).

Ecology and other information. *Ixodes nipponensis* is a tick species found in Russia in the south and south-west of the Primorsky Krai and also in the Korean peninsula and Japan (Filippova 1977). In Russia it was reported mainly from murine rodents, although in the Republic of Korea it was also observed on lizards (Kim et al. 2018) and cattle, goats, dogs, horses, and birds in Japan (Kitaoka and Saito 1967; Yamaguti et al. 1971).

Figure 11. Map of Russia and neighboring countries showing the locations where *Ixodes nipponensis* was reported.

Multiple cases of parasitism on humans have been recorded (Nakatsukase and Hatsushika 1985; Paik et al. 1989; Cho et al. 1995; Chu et al. 1997; Ryu et al. 1998; Ko et al. 2002).

Ixodes occultus Pomerantsev, 1946

Recorded hosts. Mammalia: *Crocidura suaveolens* (lesser white-toothed shrew), *Diplomesodon pulchellum* (Lichtenstein) (piebald shrew), *Meriones libycus* Lichtenstein (Libyan jird), *Meriones meridianus* (midday jird), *Meriones persicus* (Persian jird), *Mustela nivalis* (least weasel), *Nothocricetulus migratorius* (grey dwarf hamster), *Rhombomys opimus* (Lichtenstein) (great gerbil), *Spermophilopsis leptodactylus* (Lichtenstein) (long-clawed ground squirrel), *Vormela peregusna* (marbled polecat) (Filippova 1977).

Reptilia: *Gloydius halys* (Pallas) (Halys pit viper) (Filippova 1977).

Recorded locations (Fig. 12). Kazakhstan: Mangystau Region – the Mangyshlak Peninsula (Kaluzhenkova et al. 1961) and the Ustyurt Plateau; Kyzylorda Region (Filippova 1958a; Loseva 1963; Maslennikova and Ushakova 1971), Jambyl Region – the Moiynkum Desert (Maslennikova and Ushakova 1971), Almaty Region – the foothills of the Dzungarian Alatau: the Sholak and Katutau mountains, the deserts Taukum and Saryesik-Atyrau (Ushakova 1960; Maslennikova et al. 1964; Ushakova et al. 1976). **Turkmenistan:** distributed everywhere – the southern Ustyurt, the Octumkumy Desert, the Üňüzaňyrsy and Türkmenbaşy Plateau, the Meshed and Saynaksan Desert, the Karakum Desert (Pomerantsev 1950; Kerbabaev 1961; Kochkareva et al. 1971); Hojagala (Berdyev and Annaev 1997). **Uzbekistan:** the Pistalitau Ridge and the rural locality Tashrabat (Maslennikova and Ushakova 1971).

Figure 12. Map of Russia and neighboring countries showing the locations where *Ixodes occultus* was reported.

Ecology and other information. *Ixodes occultus* is a tick species inhabiting deserts. It is mainly a nidicolous parasite of gerbils and jirds (subfamily Gerbillinae), first of all, the great gerbil, as well as of those small mammals which also use long and deep burrows of great gerbils as shelters (Filippova 1977). Some predators which have strong trophic relationships with gerbils and regularly contact with their colonies act as secondary hosts for this tick species.

The type specimen of *I. occultus* is deposited at the Zoological Institute of the Russian Academy of Sciences and includes the holotype: male; Turkmenia, Repetek, *Rhombomys opimus*, 5.10.1937, coll. B.I. Pomerantsev, type; AL I550. Description – Filippova 1977: 365–371 (female, male, nymph, larva) (Filippova 2008).

Ixodes pavlovskyi Pomerantsev, 1946

Recorded hosts. Aves: *Acrocephalus dumetorum* Blyth (Blyth's reed warbler), *Acrocephalus schoenobaenus* (Linnaeus) (sedge warbler), *Anas platyrhynchos* Linnaeus (mallard), *Anthus trivialis* (tree pipit), *Calliope calliope* (Pallas) (Siberian rubythroat), *Carduelis carduelis* (European goldfinch), *Carpodacus erythrinus* (Pallas) (common rosefinch), *Chloris chloris* (Linnaeus) (European greenfinch) *Columba livia* Gmelin (rock dove), *Corvus cornix* Linnaeus (hooded crow), *Corvus corone* Linnaeus (carrion crow), *Coturnix coturnix* (Linnaeus) (common quail), *Crex crex* (Linnaeus) (corn crake), *Curruca communis* (Latham) (common whitethroat), *Curruca curruca* (Linnaeus) (lesser whitethroat), *Cyanopica cyanus* Pallas (azure-winged magpie), *Emberiza calandra* Linnaeus (corn bunting), *Emberiza citrinella* Linnaeus (yellowhammer), *Emberiza leucocephalos* Gmelin (pine bunting), *Emberiza spodocephala* Pallas (black-faced bunting), *Ficedula hypoleuca* (Pallas) (European pied flycatcher), *Fringilla coelebs* Linnaeus (Eurasian chaffinch), *Fringilla montifringilla* Linnaeus (brambling), *Lanius collurio* Linnaeus (red-backed shrike), *Locustella lanceolata* (Temminck) (lanceolated warbler), *Luscinia luscinia* (Linnaeus) (thrush nightingale), *Luscinia svecica* (Linnaeus) (bluethroat) *Parus major* Linnaeus (great tit), *Passer montanus* (Linnaeus) (Eurasian tree sparrow), *Pastor roseus* (Linnaeus) (rosy starling), *Phoenicurus phoenicurus* (Linnaeus) (common redstart), *Phylloscopus fuscatus* (Blyth) (dusky warbler), *Phylloscopus trochiloides* (Sundevall) (greenish warbler), *Pica pica* (Eurasian magpie), *Sitta europaea* Linnaeus (Eurasian nuthatch), *Sturnus vulgaris* Linnaeus (common starling), *Sylvia borin* (garden warbler), *Tetrao urogallus* (western capercaillie), *Tetrastes bonasia* (hazel grouse), *Turdus iliacus* Linnaeus (redwing), *Turdus philomelos* Brehm (song thrush), *Turdus pilaris* Linnaeus (fieldfare), *Turdus ruficollis* Pallas (red-throated thrush), *Turdus viscivorus* (mistle thrush) (Filippova 1977; Moskvitina et al. 2014).

Mammalia: *Alexandromys oeconomus* (tundra vole), *Apodemus agrarius* (striped field mouse), *Arvicola amphibius* (European water vole), *Craseomys rufocanus* (grey red-backed vole), *Cricetus cricetus* (European hamster), *Eutamias sibiricus* (Siberian chipmunk), *Lepus timidus* (mountain hare), *Microtus agrestis* (short-tailed field vole), *Microtus arvalis* (common vole), *Mus musculus* (house mouse), *Myodes glareolus* (bank vole), *Myodes rutilus* (northern red-backed vole), *Neomys fodiens* (Eurasian water shrew), *Nothocricetulus migratorius* (grey dwarf hamster), *Ochotona alpina* (Alpine pika), *Sciurus vulgaris* (red squirrel), *Sicista betulina* (northern birch mouse), *Sicista subtilis* (Pallas) (southern

Figure 13. Map of Russia and neighboring countries showing the locations where *Ixodes pavlovskyi* was reported.

birch mouse), *Sorex araneus* (common shrew), *Sorex minutus* (Eurasian pygmy shrew), *Sorex roboratus* (flat-skulled shrew), *Stenocranius gregalis* (Pallas) (narrow-headed vole) (Filippova 1977).

Recorded locations (Fig. 13). Russia: Tomsk Oblast (Kovalev et al. 2015), Novosibirsk Oblast, Altai Republic (Tkachev et al. 2017), Altai Krai, Kemerovo Oblast, Krasnoyarsk Krai, Khakassia, northern spurs of the Western Sayan, Amur Oblast, Khabarovsk, Primorsky Krai – the Sikhote-Alin (Filippova 1969; Sapegina and Ravkin 1969; Filippova and Panova 1998), Russky Island (Nikitin et al. 2021). **Kazakhstan:** East Kazakhstan Region (Tkachev et al. 2017; Perfilyeva et al. 2020), Abai Region, Jetisu Region (Filippova 1977), Tarbagatai Mountains, Dzungarian Alatau, Küngöy Ala-Too Range (Ushakova et al. 1976; Filippova and Panova 1998). **Kyrgyzstan:** Küngöy Ala-Too Range (Filippova and Panova 1998), Terskey Ala-too (Fedorova 2017).

Ecology and other information. *Ixodes pavlovskyi* is a tick species distributed in Western Siberia, the Far East, Eastern Kazakhstan, and Kyrgyzstan (Filippova 1977; Fedorova 2017), as well as in China (Guo et el. 2016) and Japan (Nakao et al. 1992; Guglielmone et al. 2023). It more often prefers birds as hosts, as well as small mammals although some cases of human and livestock infestation are also recorded. Its preferred habitats include usually coniferous and deciduous forests, undergrowth, as well as motley grass (Filippova 1977).

Often it can be found in the same biotopes together with *I. persulcatus* with complete coincidence of the seasons of activity of both species at each ontogenetic stage (Filippova 1999) and where their hybridization can also occur (Kovalev et al. 2015; Rar et al. 2019).

In certain areas of Siberia *I. pavlovskyi* outnumbers *I. persulcatus* and also other tick species due to the high abundance of ground-feeding birds, especially in urban landscapes with habitats suitable for ticks like parks and cemeteries. So, for example, in the city of Tomsk in Western Siberia *I. pavlovskyi* dominates

everywhere in the city and its outskirts (Romanenko 2011). Probably eventually over time *I. persulcatus* was gradually replaced by *I. pavlovskyi* because it is too difficult for adult *I. persulcatus* to find its preferred hosts, namely mammals (Romanenko and Leonovich 2015).

Filippova and Panova (1998) recognize two subspecies in Russian populations of this tick, namely *I. pavlovskyi pavlovskyi* and *I. pavlovskyi occidentalis* which differentiation is based on morphological features between western and eastern specimens.

The type specimens of *I. pavlovskyi* are deposited at the Zoological Institute of the Russian Academy of Sciences and include *I. pavlovskyi*, Pomerantsev (Pomerantsev 1946: 11), the holotype: female; [Russia], DVK [Primorskii Terr.], Imanskii Forestry, hazel, 2.9.1932, type; AL I513. Description – Filippova 1977: 305–312 (female, male, nymph, larva); as well as *I. pavlovskyi* subsp. *occidentalis* (Filippova and Panova 1998: 396–411 – female, male, nymph, larva) the holotype: female; Russia, western foothills of Kuznetskii Ala Tau, basin of upper Tom River, environs of Mezhdurechensk, from vegetation, flagging, 24.5.1972, coll. E.D. Chigirik, det. N.A. Filippova; AL I1016 and finally *I. pavlovskyi* subsp. *pavlovskyi* (Filippova and Panova 1998: 396–411, female, male, nymph, larva), the holotype (the same as the holotype of the species): see *I. pavlovskyi* (Filippova 2008).

Ixodes persulcatus Schulze, 1930

Ixodes persulcatus Schulze, 1930: 294.
Ixodes ricinus miyazakiensis Kishida: Morel and Pérez 1978: 201.
Ixodes persulcatus diversipalpis Schulze, 1930: 294; Pomerantsev 1950: 43.
Ixodes persulcatus cornuatus Olenev: Pomerantsev 1950: 43.
Ixodes sachalinensis Filippova: Kolonin 1981: 49.

Recorded hosts. The spectrum of hosts of *I. persulcatus* is extremely broad both systematically and ecologically and includes more than 200 species of mammals and 100 species of birds (Shilova and Clabovskii 1968). Rarely it can parasitize reptiles – lizards of the family Lacertidae (Ravkin 1969). Literally almost all mammals and birds inhabiting various types of forests and their derivative biotopes can act as hosts for *I. persulcatus*. Larvae and nymphs parasitize more often small and medium-sized mammals, such as shrews, hedgehogs, rodents, and lagomorphs, as well as ground-feeding and ground-nesting birds. Adults usually feed on large and medium-sized mammals – ungulates, carnivores, lagomorphs. Humans and domestic animals can also be hosts for this tick species (Filippova 1977).

Distribution in Russia and other post-Soviet countries (Fig. 14). The range of *I. persulcatus*, like no other Palearctic species, is extended in the latitudinal direction by a continuous strip, covering a significant part of the taiga forest zone in Eurasia between 21°–66° latitude in the northern hemisphere from the Scandinavian Peninsula, the Baltic states, Belarus and Ukraine in the west where it is present sporadically to the east up to the Pacific coast including the Kamchatka Peninsula and the Sakhalin Island and further to the north-east of China, the Korean Peninsula and Japan (Filippova 1977; Wang et al. 2023). This tick belongs to the tick fauna of the next post-Soviet countries: Estonia, Latvia,

Figure 14. Map of Russia and neighboring countries showing the locations where *Ixodes persulcatus* was reported.

Lithuania, Belarus, Russia, Ukraine, Kazakhstan, Kyrgyzstan (Guglielmone et al. 2023). The presence of *I. persulcatus* in Ukraine outside the south-west border of the taiga was mentioned by Filippova (1977), although the possibility of permanent populations existing there was disputed by Nebogatkin (1993). Therefore, this probably exemplifies transportation by migratory birds.

Ecology and other information. *Ixodes persulcatus* is an exophilic tick species widely distributed in the northern Palearctic along the forest zone. It may use almost all mammals and birds living in its biotopes; therefore, it is one of the most important vectors of a broad range of tick-borne pathogens. Since it can also transmit tick-borne encephalitis virus, together with *I. ricinus* it has the greatest medical and veterinary significance among other ticks of the genus *Ixodes* in the Palearctic. Another important fact is that *I. persulcatus* is a very aggressive species toward humans (Uspensky 1993) and, therefore, this species represents especially high medical-epidemiological risks.

The most significant part of the range of *I. persulcatus* stretches across the territory of Russia where we can observe the full spectrum of biotopes where *I. persulcatus* can be found. There are a lot of published works about its ecology in different regions which depend on the climatic region and biotic-abiotic conditions in it.

This tick prefers various types of forest and forest-steppe biotopes, especially taiga forests and their derivatives, i.e., mixed forests and bushes (both plain and mountainous), up to 2000 m a.s.l., like in the Tian Shan. In other words, it can inhabit any herbaceous forest and forest-steppe biotope with the level of humidity high enough for reproduction and supporting the life cycle, even in urban landscapes (Filippova 1977). In the Dzungarian Alatau there were some observations of occurring in steppe regions bordering forests and parasitizing the unusual host, namely the grey marmot *Marmota baibacina* Kastschenko (Bibikov et al. 1961). Permanent and stable populations of *I. persulcatus* exist in some areas adjacent

to cities within its range and even inside these cities on condition that the the suitable forest environment together with hosts, such as wild animals of different sizes and stray dogs are present. Examples of such cities are Saint Petersburg, Petrozavodsk, Novosibirsk, Tomsk, Irkutsk, and Vladivostok (Uspensky 2017).

Several studies attest the changing boundaries of the ranges of *I. persulcatus*. It is assumed that ticks of the *I. presulcatus* group appeared and evolved in forest biotopes similar to modern relict forests of the Ussuri type and the taiga of the mountains of Southern Primorye, Southern Siberia, and the Korean Peninsula in the Pliocene. The wide ecological niche of *I. persulcatus* was formed during the formation of the species in the process of its adaptation to various landscape and climatic conditions. This allowed the species to gradually expand its range in the northwestern direction in the Holocene (Filippova 2017). An increase in air temperature by one or several degrees in a particular region near the boundaries of its range was probably the main driver of its expanding distribution. The fact of finding *I. presulcatus* populations in Sweden (Jaenson et al. 2016) and even in the Magadan Oblast in the north-east of Russia where it was absent before (Yamborko et al. 2015) are good examples of the distribution expansion in several directions and confirm the tendency which continues.

In Russia, high numbers of observations show noticeable changes in the distribution of *I. persulcatus* in certain regions. In Karelia the range expansion of *I. persulcatus* to the north is noted in relation to general climate warming (Bugmyrin et al. 2013). A similar observation was also recorded in the Komi Republic (Glushakova et al. 2011). The range expansion of this tick species in Arkhangelsk Oblast and Western and Central Siberia to the north is confirmed both by the results of their records and by the data on tick bites and morbidity in the human population, not only in places which were free from ticks before (Pogodina 2021). Besides that, there are some data about the range expansion of *I. persulcatus* to the north in the Republic of Sakha (Yakutia). The reasons causing these changes are under evaluation but climate change, anthropogenic pressure in natural landscapes as well as the number of vertebrate animals are among the most influential factors. At the same time, it is also possible that inadvertent dispersal of ticks by timber material transported from tick-infested areas may be in part responsible for this phenomenon (Danchinova et al. 2006). Although other factors are not excluded, it is believed that climate changes have made the greatest contribution to the increase in areas primarily for TBE foci in the northern regions of the country. But despite all this, as a result of the same changes, the southwestern part of the range of *I. persulcatus* in Belarus and the Baltic countries has decreased (Pogodina 2021).

Often it can be found in the same biotopes together with *I. ricinus* in Europe and *I. pavlovskyi* in Siberia with complete or partial coincidence of the seasonal activity of these species at each ontogenetic stage (Ushakova and Filippova 1968; Bolotin et al. 1977; Filippova 1999). In zones of sympatry their hybridization can occur, and their hybrids can also transmit tick-borne encephalitis virus and probably other pathogens (Kovalev et al. 2015; Rar et al. 2019; Belova et al. 2023). Under laboratory conditions, interspecific hybridization between *I. ricinus* and *I. persulcatus* was successfully conducted as well. F1 hybrid ticks were completely sterile, as revealed by unsuccessful attempts of their subsequent hybridization with ticks of the parent generation (Balashov et al. 1998). In *I. persulcatus* and *I. ricinus*, any morphological barrier to crossing is undoubdetly

absent and then sterility of the F1 hybrid generation is probably a quite significant factor limiting the population size of both species in their sympatric areas. Hybrid ticks also have morphological features allowing to differentiate them at preimaginal and imaginal stages (Bugmyrin et al. 2015, 2016). Moreover, some studies were conducted in the Southern Primorye (Filippova 2002) in sympatric zones of *I. persulcatus* and *I. pavlovskyi occidentalis*, due to the close cohabitation of both species. These showed that in case of these two species there are distinct morphological barriers which are manifested in the fitting of organs involved in mating, in particular their size proportions. According to the result of the studies, mating and hybridization of different tick species are possible only in the next combination: female *I. pavlovskyi* and male *I. persulcatus*. Whereas in case of the reverse combination, the parameters of the genital aperture of the female exceed those of the largest width of the hypostome in the male.

There is an excellent summary on the questing behavior of *I. persulcatus* in the monograph by Filippova (1985). In brief, the ticks climb onto the vegetation in quest of a host. When the host approaches, the tick spreads its first pair of legs and, upon contact with the host, become attached. From time to time, ticks perform vertical migrations and go even into the soil litter for rehydration. Horizontal movements of ticks towards trails used by potential hosts are also possible, as well as crawling onto a nearby animal. Ticks react to humans by spreading their first legs from distances of ~ 15–20 m. At short distances, ticks also react to a heat source. In general, a similar pattern of questing behavior is used by other exophilic ticks of the genus *Ixodes*.

In *I. persulcatus* there is an important signaling mechanism causing a morphogenetic diapause – a developmental delay which is the response of ticks to the duration of the diurnal photoperiod (Belozerov 1976). Moreover, *I. persulcatus* has a behavioral diapause of non-engorged adult ticks, which is not connected with photoperiodic regulation (Korenberg et al. 2021). But as the studies in the Kirov Oblast and Udmurt Republic showed, in more warmer areas, an increased proportion of engorged larvae and nymphs develop without the diapause and the reason for this is the early activation and, as a result, their mass feeding on hosts in the first half of summer. The factors determining the diapause of engorged larvae and nymphs in the compared regions practically do not differ (Korotkov 2008). The correlation of the tick number varies, depending on the type of biotope, as well as temperature and humidity and also many other abiotic factors. For example, in boreal taiga forests of Karelia mainly *I. persulcatus* dominates (except the southwestern part where the mass species is *I. ricinus*) (Bugmyrin et al. 2013). The beginning of adult *I. persulcatus* activity also differs in different regions depending on the sum of abiotic factors listed above. For example, in the Far East the seasonal peak in the number of larvae is observed in the third decade of May – second decade of July, whereas in the European part of its range in the third decade of July (Belozerov 1976; Filippova 1977; Balashov 1998; Korenberg et al. 2013). In the territory from the Volga River to Primorye the average activity of adult ticks varies from 60 to 140 days (Korenberg et al. 1974). The boundaries of the range of the tick are determined mainly by the combination of photo- and hygrothermal factors. The general indicators of warmth and moisture along the range of this tick species vary widely. The fundamental ecological niche of *I. persulcatus* with the broad scope of its preferred conditions allows it to adapt to the wide diversity of biotopes in the forest zone.

Some type specimens of *I. persulcatus* are deposited at the Zoological Institute of the Russian Academy of Sciences and include *I. persulcatus* subsp. *diversipalpis* (Schulze 1930: 300), lectotype: male; [Russia, Primorskii Terr.], lower Amur River, 8 km of Vyatskoe Vill., 26.VI.1910, coll. Soldatov, det. N.O. Olenev: *I. ricinus ovatus*; AL I266, as well as the paralectotypes: 1 female, 1 male; AL I266a. *I. persulcatus* (see: Filippova 1969: 677). Description – Filippova 1977: 316–327 (female, male, nymph, larva) (Filippova 2008). But Filippova (1969) also states that re-examination of the type material of the above subspecies demonstrated that the specimens used for describing differences of this subspecies are damaged in some morphologically important parts (not noticed before), and the key morphological characters that were previously thought to distinguish the subspecies are not specific enough and can be found in ticks throughout their entire geographical range.

Ixodes redikorzevi Olenev, 1927

Ixodes redikorzevi Olenev, 1927: 219.

Recorded hosts. Mammalia: *Apodemus agrarius* (striped field mouse), *Apodemus mystacinus* (Danford and Alston) (eastern broad-toothed field mouse), *Apodemus uralensis* (Ural field mouse), *Arvicola amphibius* (European water vole), *Chionomys nivalis* (European snow vole), *Chionomys roberti* (Thomas) (Robert's snow vole), *Cricetus cricetus* (European hamster), *Crocidura leucodon* (bicolored shrew), *Crocidura suaveolens* (lesser white-toothed shrew), *Dryomys nitedula* (forest dormouse), *Erinaceus europaeus* (European hedgehog), *Glis glis* (European edible dormouse), *Hemiechinus auratus* (long-eared hedgehog), *Lepus europaeus* (European hare), *Marmota bobak* (bobak marmot), *Martes martes* (European pine marten), *Meles meles* (European badger), *Meriones libycus* (Libyan jird), *Meriones meridianus* (midday jird), *Meriones persicus* (Persian jird), *Meriones tamariscinus* (Pallas) (tamarisk jird), *Meriones tristrami* Thomas (Tristram's jird), *Mesocricetus auratus* Waterhouse (golden hamster), *Mesocricetus raddei* (Ciscaucasian hamster), *Microtus arvalis* (common vole), *Microtus majori* (Major's pine vole), *Microtus socialis* (social vole), *Mus musculus* (house mouse), *Mustela eversmanii* (steppe polecat), *Mustela nivalis* (least weasel), *Nesokia indica* (short-tailed bandicoot rat), *Nothocricetulus migratorius* (grey dwarf hamster), *Rattus norvegicus* (brown rat), *Rattus pyctoris* (Turkestan rat), *Rattus rattus* (black rat), *Rhombomys opim*us (great gerbil), *Sciurus anomalus* Gmelin (Caucasian squirrel), *Sciurus vulgaris* (red squirrel), *Sicista betulina* (northern birch mouse), *Sicista subtilis* (southern birch mouse) *Spalax giganteus* Nehring (giant blind mole-rat), *Spalax microphthalmos* Gueldenstaedt (greater blind mole-rat), *Spermophilopsis leptodactylus* (long-clawed ground squirrel), *Spermophilus pygmaeus* (little ground squirrel), *Sorex araneus* (common shrew), *Vormela peregusna* (marbled polecat) *Vulpes vulpes* (red fox) (Filippova 1977).

Aves: *Alauda arvensis* Linnaeus (Eurasian skylark), *Alectoris chukar* (chukar partridge), *Anthus campestris* (tawny pipit), *Anthus pratensis* (Linnaeus) (meadow pipit), Coccothraustes coccothraustes (hawfinch), *Columba livia* (rock dove), *Emberiza calandra* (corn bunting), *Emberiza schoeniclus* (Linnaeus) (common reed bunting), *Erithacus rubecula* (Linnaeus) (European robin),

Galerida cristata (crested lark), *Garrulus glandarius* (Linnaeus) (Eurasian jay), *Lullula arborea* (woodlark), *Melanocorypha calandra* (Linnaeus) (calandra lark), *Mergus serrator* Linnaeus (red-breasted merganser), *Oenanthe hispanica* (Linnaeus) (western black-eared wheatear), *Oenanthe isabellina* (Temminck) (Isabelline wheatear), *Oenanthe lugens* (Lichtenstein) (mourning wheatear), *Oenanthe oenanthe* (Linnaeus) (northern wheatear), *Oenanthe picata* (Blyth) (variable wheatear), *Phylloscopus collybita* (Vieillot) (common chiffchaff), *Phylloscopus fuscatus* (dusky warbler), *Pica pica* (Eurasian magpie), *Pterocles orientalis* (Linnaeus) (black-bellied sandgrouse), *Saxicola torquatus* (Linnaeus) (African stonechat), *Sturnus vulgaris* (common starling), *Turdus merula* (common blackbird), *Turdus philomelos* (song thrush), *Turdus ruficollis* (red-throated thrush) (Filippova 1977).

Reptilia: *Darevskia chlorogaster* (Boulenger) (greenbelly lizard) (Orlova et al. 2022), *Lacerta agilis* Linnaeus (sand lizard) (Filippova 1977), *Lacerta strigata* Eichwald (Caucasus emerald lizard) (Orlova et al. 2023), *Pseudopus apodus* (Pallas) (Pallas's glass lizard) (Filippova 1977).

Recorded locations (Fig. 15). Russia: Rostov Oblast (Khametova et al. 2018), Krasnodar Krai, Stavropol Krai, Kalmyk Republic, Chechnya, Dagestan, and North Osetia-Alania (Shatas 1957; Shevchenko et al. 1960; Zaytsev and Popova 1967; Tiflova 1974; Filippova 1977; Abdulmagomedov et al. 2017; Zaytseva et al. 2022). **Ukraine:** Odesa Oblast (Bugeac Steppe), Kherson Oblast (Black Sea Biosphere Reserve), Poltava Oblast, Chernivtsi Oblast, Dnipropetrovsk Oblast, Luhansk Oblast, Donetsk Oblast, widely distributed in the Crimean Peninsula (Emchuk 1960; Emchuk 1967; Sklyar 1970; Filippova 1977). **Moldova:** the north of the country (Uspenskaya et al. 2006). **Georgia:** outskirts of Kutaisi and Tbilisi and the Lagodekhi Nature Reserve, as well as the seacoast of the Black Sea (Kirschenblatt 1936; Djaparidze 1960; Filippova 1977). **Armenia:** outskirts of

Figure 15. Map of Russia and neighboring countries showing the locations where *Ixodes redikorzevi* was reported.

Yerevan and most of the rest of the territory (Zilfyan et al. 1960; Tiflova 1974). **Azerbaijan:** Zagatala State Reserve, Hadrut District, and the Mil plain (Tiflova 1974), outskirts of the Bilasuvar, the Sara Peninsula (Kirschenblatt 1936), Talysh (Pomerantsev 1950), Nakhchivan Autonomous Republic (Kadatskaya and Shirova 1963; Filippova 1977). **Kazakhstan:** West Kazakhstan Region, Kyzylorda Region, North Kazakhstan Region, Jambyl Region, Turkistan Region, Abai Region (Loseva 1963; Popova and Sokolova 1963). **Kyrgyzstan:** outskirts of Bishkek, Chüy Valley, Talas Valley, Issyk-Kul Basin, Terskey Ala-too Range (Filippova 1958b; Grebenyuk 1966; Filippova 1977). **Turkmenistan:** foothills of the Uly Balkan and the Kopet Dagh; the Kugitangtau Range (Kochkareva et al. 1971; Filippova 1977). **Uzbekistan:** outskirts of Tashkent, foothills of the Chatkal Range, Qurama Mountains, the Hisar Range, the Kugitangtau Range and Karakalpakstan – the Ustyurt Plateau and the lower reaches of the Amu Darya River (Kuklina 1967; Uzakov 1972; Filippova 1977). **Tajikistan:** Hisar Range - Varzob gorge, outskirts of Dushanbe – the Ramit State Nature Reserve, Vakhsh Range, Peter the First Range (Lotozky 1951; Sosnina 1957; Filippova et al. 1966; Kochkareva et al. 1971; Filippova 1977).

Ecology and other information. *Ixodes redikorzevi* is a tick species which is mainly a parasite of rodents, shrews, and small carnivores, as well as of dendrophilic ground-feeding birds and rarely reptiles (Filippova 1977). According to Tiflova (1974), this species is considered exophilic and can be found in significant numbers on dendrophilic birds. In the absence of mammalian and avian hosts, *I. redikorzevi* can parasitize lizards in significant numbers (Orlova et al. 2022). It usually inhabits mountain deciduous forests and steppes located nearby.

Beyond the post-Soviet territories considered above, the range of this tick covers also Eastern Europe, Turkey, Israel, as well as Afghanistan (Filippova 1977) and China (Yin et al. 2010).

At the current moment it is still questionable whether *I. redikorzevi* is a synonym of *I. acuminatus* or not. Kolonin (2009) considers this species a synonym of *I. acuminatus*, but Guglielmone et al. (2010) regard it as provisionally valid. As it was fairly noted by Guglielmone et al. (2014) this question can be solved by comparison of the type specimens of both species. Moreover, Pomerantsev (1950) described by females two subspecies: *I. redikorzevi redikorzevi* and *I. redikorzevi emberizae*. Later the other subspecies *I. redikorzevi theodori* was described although Filippova comments (1977) that the authors had quite little material during descriptions but the differences in size and shape of some characters are visible and it is necessary to compare more specimens from more locations of its large area of distribution.

Ixodes redikorzevi redikorzevi occurs in Ukraine, the Transcaucasus and Tajikistan according to Pomerantsev (1950); and *I. redikorzevi emberizae* can be found in Lankaran and the Hisar Range in Tajikistan. Later the other subspecies, *I. redikorzevi theodori* was described from the Middle East (Warburton 1927).

The type specimens of *I. redikorzevi* are deposited at the Zoological Institute of the Russian Academy of Sciences and include the holotype: female; [former] Tavricheskaya Province (Crimea), Yaman-Kala, near Baidar, 25.10.1924, coll. V. Shnitnikov, AL I338 and the paralectotype of *I. redikorzevi emberizae* female; AL I522. Description – Pomerantsev 1950: 63 (female; male unknown); Filippova 1977: nymph, larva (Filippova 2008).

Ixodes ricinus (Linnaeus, 1758)

Acarus ricinus Linnaeus, 1758: 616.
Ixodes reduvius (Linnaeus): Neumann 1911: 12.
Ixodes sanguisugus (Linnaeus): Morel and Pérez 1978: 201.
Ixodes vulgaris (Fabricius): Neumann 1911: 12.
Ixodes holsatus (Fabricius): Nuttall and Warburton 1911: 285.
Ixodes megathyreus Leach: Neumann 1911: 12.
Ixodes bipunctatus Risso: Neumann 1911: 12.
Ixodes trabeatus Audouin: Neumann 1911: 12.
Ixodes marginalis Hahn: Oudemans 1896: 191.
Ixodes sciuri Koch: Neumann 1911: 12.
Ixodes fuscus Koch: Neumann 1911: 12.
Ixodes sulcatus Koch: Neumann 1911: 12.
Ixodes rufus Koch: Neumann 1901: 249.
Ixodes lacertae Koch: Neumann 1911: 12.
Ixodes pustularum Mégnin: Neumann 1911: 12.
Ixodes vicinus Yerrill: Oudemans 1896: 191.
Ixodes fodiens Murray: Neumann 1904: 444.
Ixodes nigricans Neumann: Schulze 1939: 1.
Ixodes areolaris Olenev: Pomerantsev 1950: 37.

Recorded hosts. The host spectrum of *I. ricinus* is extremely broad both systematically and ecologically, including literally almost all mammals and birds of its geographical range, rarely even reptiles inhabiting the same biotopes with the tick. The fact of mass parasitism of immature stages on lizards of the Lacertidae family, in particular species of the genus *Darevskia* in the Caucasus (Kidov et al. 2013; Orlova et al. 2022) in habitats where they outnumber small mammals probably brightly demonstrates that *I. ricinus* is a generalist tick capable to use almost any available terrestrial vertebrates as hosts. Overall, the list of hosts consists of more than 300 species of mammals, birds and reptiles which have been recorded (Gern et al. 2002). Humans and domestic animals can also be hosts for the tick (Filippova 1977).

Distribution (Fig. 16). The distribution of *I. ricinus* in Russia includes almost the whole territory of its European part excluding subpolar tundra areas (see the map) (Filippova 1977; Kahl and Gray 2023) and due to climate changes, the distribution of this tick species becomes wider (Gray et al. 2009; Yasyukevich et al. 2009). *Ixodes ricinus* is part of the tick fauna of the following post-Soviet countries: Estonia, Latvia, Lithuania, Belarus, Russia, Ukraine, Moldova, Georgia, Azerbaijan, Armenia, Turkmenistan, and Kazakhstan (Guglielmone et al. 2023). In Kazakhstan a little number of specimens were found in the northern part of West Kazakhstan Oblast (Maikanov 2012). In Turkmenistan the tick was also recorded in few numbers in the western foothills of the Kopet-Dag (Kerbabaev 1960) which probably could be transported there by migratory birds.

Ecology and other information. *Ixodes ricinus* is an exophilic tick species widely distributed in Europe, mostly inhabiting deciduous and mixed forest zones in both plain and mountainous areas, as well as forest-steppes bordering them. It also occurs in city parks and gardens (Gray 1998). In addition, it can be found in North Africa (Arthur 1965). In Ukraine *I. ricinus* colonized and reached

Figure 16. Map of Russia and neighboring countries showing the locations where *Ixodes ricinus* was reported: **A** before 1975 **B** from 1976.

a high abundance in artificial forest plantations of the Askania-Nova Nature Reserve surrounded from all sides by steppes for a period of less than 80 years (Emchuk 1972). In urban areas with conditions able to support tick populations, for example, Minsk or Kyiv, *I. ricinus* usually dominates among other tick species, especially among members of the genus *Ixodes* (Uspensky 2017). This tick species uses almost all forest vertebrate animals as hosts and, together with *I. persulcatus*, it is one of the most important vectors of a broad spectrum of tick-borne pathogens, first of all, tick-borne encephalitis virus (Filippova 1977).

Often it can be found in the same biotope with *I. persulcatus*, often exhibiting complete or partial coincidence of seasonal activity at each ontogenetic stage (Filippova 1999). In zones of sympatry their hybridization can occur, and although hybrid offspring are incapable of reproduction (Bugmyrin et al. 2015), they can still transmit tick-borne encephalitis virus and probably other pathogens (Kovalev et al. 2016; Belova et al. 2023). The absence of any morphological barrier for copulation was discovered in geographical points of probably the secondary sympatric zone (Filippova 2002) of *I. persulcatus* and *I. ricinus* in the north-west of the East European Plain (Balashov et al. 1998). However, in some areas of this sympatric zone, for example, in southern Kare-

lia, its slight shrinking has recently been noted due to the withdrawal of *I. ricinus* from territories where it used to live (Bespyatova and Bugmyrin 2021).

Due to the high epidemiological significance and wide distribution of *I. ricinus* and its regular contacts with humans and domestic animals, its biology and life cycle were more extensively studied than in case of any other species of its genus inhabiting the same territories. As a species, *I. ricinus* probably appeared approximately 8–12 thousand years ago when deciduous and mixed forests formed in the southeast of Europe and the Mediterranean, as well as in the northern and northeastern slopes of the Greater Caucasus, when current environmental conditions of these territories have begun to shape. And the climate there was also milder than in Siberian taiga forests where *I. persulcatus* evolved (Filippova 2017).

It was revealed that in a certain region the duration of tick activity period and the number of adult ticks depend on spring and summer temperatures and air humidity (Korotkov et al. 2015; Korenberg et al. 2021). Females and larvae usually attach to hosts when the air near the soil warms up from +2 to +30 °C, and in the case of nymphs from +2 to +22 °C. The relative humidity of the surrounding air has to be higher than 60% for an extended period of time (Sirotkin and Korenberg 2018). It is absolutely important for ticks to receive the necessary amount of warmth to complete their metamorphosis at each stage within a strictly defined period of time (Korenberg et al. 2013). As a consequence, the seasonal activity of all stages of *I. ricinus* is more extended than in the case of *I. persulcatus*, and engorged ticks begin oviposition or metamorphosis without strict dependance on the photoperiod. Therefore, in the southern range of distribution (the Mediterranean, Central Europe, the Caucasus) ticks initiate activity in the end of March – the beginning of April (Korenberg et al. 2021), whereas in Eastern European regions – in April (Medvedev et al. 2016; Korenberg et al. 2021). *Ixodes ricinus* also uses a diapause as a biological mechanism, although due to warmer conditions in the majority of its distribution range, no more than 10–20% of ticks at each stage undergo such an interruption of development (Korenberg and Kovalevsky 1977; Korenberg et al. 2016).

***Ixodes sachalinensis* Filippova, 1971**

Ixodes sachalinensis Filippova, 1971: 236; Kolonin 1981: 49.
Ixodes persulcatus diversipalpis Schulze, 1930: 294; Pomerantsev 1950: 43.
Ixodes persulcatus cornuatus Olenev: Pomerantsev 1950: 43.

Recorded hosts. Mammalia: *Lepus timidus* (mountain hare) (Filippova 1977).

Recorded locations (Fig. 17). Russia: the Sakhalin Island, Sachalin Oblast, the rural locality Khomutovo (Filippova 1971).

Ecology and other information. *Ixodes sachalinensis* is a tick species known only by the single finding from Sakhalin. It was collected from a mountain hare together with 79 females, 15 males and 7 nymphs of *I. persulcatus* (Filippova 1971).

Kolonin (2009) and Camicas et al. (1998) consider *I. sachalinensis* a synonym of *I. persulcatus*, but Barker and Murrell (2004) and Guglielmone et al. (2009, 2010) recognize this species as valid.

The type specimen is deposited at the Zoological Institute of the Russian Academy of Sciences and includes the holotype: female; [Russia], Sakhalin, near Khomutovo Vill., *Lepus timidus*, 27.5.1950, [coll.: unknown]; AL I729 (Filippova 2008).

Figure 17. Map of Russia and neighboring countries showing the locations where *Ixodes sachalinensis* was reported.

Subgenus *Ixodiopsis* Filippova, 1957: 31.

***Ixodes angustus* Neumann, 1899**

Ixodes angustus Neumann, 1899: 136.

Recorded hosts. Mammalia: *Alexandromys oeconomus* (tundra vole), *Craseomys rufocanus* (grey red-backed vole), *Eutamias sibiricus* (Siberian chipmunk), *Mus musculus* (house mouse), *Myodes rutilus* (northern red-backed vole), *Ochotona alpina* (alpine pika), *Rattus norvegicus* (brown rat), *Sicista caudata* Thomas (long-tailed birch mouse), *Sorex araneus* (common shrew), *Sorex minutus* (Eurasian pygmy shrew) (Filippova 1977).

Recorded locations (Fig. 18). Russia: outskirts of Magadan and the lower reaches of the Kukhtui River, Okhotsky district – the northernmost points of record of *I. angustus* in the Palearctic (Belyaev 1963); Kamchatka Peninsula – outskirts of the villages Tigil and Ust-Khayryuzovo (Pomerantsev 1950), the valley of the Kamchatka River to Ust-Kamchatsk (Serdjukova 1956), the eastern coast of the Kamchatka peninsula to Petropavlovsk-Kamchatsky (Speranskaya 1958), the valley of the rivers Avacha and Pinachevskaya (Paramonov et al. 1966); Middle Outer Manchuria (Filippova 1977); Sovetsko-Gavansky district (Emelyanova and Koshkin 1962); Sikhote-Alin (Belyaev and Filippova 1976); Sakhalin – Novoaleksandrovka (former Konuma), the valley of the Lyutoga River (Pomerantsev 1950) and the Cape Patience (Skrynnik 1950; Asanuma 1951; Violovich 1958, 1960; Savitsky and Okuntsova 1967; Timofeeva and Kon'kova 1971); Kuril Islands – Simushir (Pomerantsev 1950; Violovich 1958, 1960; Timofeeva and Kon'kova 1971).

Ecology and other information. *Ixodes angustus* occurs in the Palearctic predominantly on the East Asian coast and also in the Nearctic – Canada and the USA (Filippova 1977). In the Russian Far East in Outer Manchuria, the islands

Figure 18. Map of Russia and neighboring countries showing the locations where *Ixodes angustus* was reported.

and along the main ridges of the Sikhote-Alin it inhabits a wide range of biotopes: various types of mixed and broad-leaved forests in mountains and valleys, as well as tundra and rocks, stone outcrops, coastal biotopes, meadow and river valleys (Speranskaya 1958; Violovich 1958; Emelyanova and Koshkin 1962; Belyaev 1963; Paramonov et al. 1966; Savitsky and Okuntsova 1967; Belyaev and Filippova 1976).

Ixodes angustus is considered a nidicolous ectoparasite of rodents and shrews because it was found not only on hosts but also in their burrows (Filippova 1977), although there are documented cases on this species biting humans without contacts with burrows (Cooley 1946). As a parasite which is connected with rodents, and, like other rodent ticks, *I. angustus* plays a role in supporting natural foci of tick-borne infections such as anaplasmosis (Yamborko and Eremeeva 2014) and the Lyme disease (Peavey et al. 2000).

Although hyperparasitism is not common in *Ixodes* ticks, *I. angustus* belongs to a small number of species of the genus, in which this phenomenon was recorded (Durden et al. 2018), when a male was feeding from a female attached to a red squirrel *Tamiasciurus hudsonicus*. The other *Ixodes* species in which males have been recorded to attach and feed on engorging conspecific females include *I. holocyclus* in Australia and *I. pilosus* in South Africa (Oliver et al. 1986).

Ixodes pomerantzevi Serdjukova, 1941

Ixodes pomerantzevi Serdjukova, 1941: 519.

Recorded hosts. Mammalia: *Apodemus agrarius* (striped field mouse), *Craseomys rufocanus* (grey red-backed vole), *Erinaceus amurensis* Schrenk (Amur hedgehog), *Eutamias sibiricus* (Siberian chipmunk), *Microtus fortis* (reed vole), *Myodes rutilus*

(northern red-backed vole), *Sorex araneus* (common shrew) (Filippova 1977), *Sorex caecutiens* (Laxmann's shrew), *Sorex unguiculatus* Dobson (long-clawed shrew), (individual specimens ((Okulova et al. 1986), *Rattus norvegicus* (brown rat), *Tscherskia triton* (De Winton) (greater long-tailed hamster) (Filippova 1977).

Recorded locations (Fig. 19). Russia: Sikhote-Alin – outskirts of Dal'ny Kut (the northernmost point of finding (Filippova 1977), valley of the Dorozhnaya River, Dalnegorsk, Ussurisky (former Komarovskii) Nature Reserve; coast of the Sea of Japan – outskirts of the villages Terney, Dukhovo, Kamenka, Lazovsky nature reserve, Fokino (former Promyslovka), the bays Razboynik and Linda; the coast of the Peter the Great Gulf: Kedrovaya Pad Nature Reserve, the rural localities Barabash and Posyet (Serdjukova 1941; Pomerantsev 1950; Slonov 1961; Khudyakov 1963; Belyaev and Filippova 1976).

Ecology and other information. *Ixodes pomerantzevi* is a relict species occurring on the East Asian coast (Filippova 1977) and in Russia its distribution is limited to a few locations in Outer Manchuria (a.k.a. Primorsky Krai) in the Russian Far East (Tsapko 2020). It is also known to occur in Korea (Kim et al. 2009a, 2010, 2011) and China (Guo et al. 2016). Predominantly it can be found in coniferous and broad-leaf forests, or secondary forests and bush thickets, as well as rock and stone outcrops among trees in the Sikhote-Alin and on the coast of the Sea of Japan (Belyaev and Filippova 1976).

Luh and Woo (1950) supposed that *I. pomerantzevi* is possibly a synonym of *Ixodes angustus*; Filippova (1977) considered it as valid and in the last list of valid tick species names, it is also considered valid (Guglielmone et al. 2020).

Ixodes pomerantzevi is a nidicolous tick species, an ectoparasite of rodents, hedgehogs, and shrews (Filippova 1977).

The type specimen of *I. pomerantzevi* is deposited at the Zoological Institute of the Russian Academy of Sciences and include the holotype: female; [Russia], DVK

Figure 19. Map of Russia and neighboring countries showing the locations where *Ixodes pomerantzevi* was reported.

[Primorskii Terr.], Suputinskii [Komarovskii or Ussurisky] Nature Reserve, from *Myodes rufocanus*, 9–13.VI.1939, coll. B.I. Pomerantsev; AL I502. Description – Filippova 1977: 128–132 (female, male - unknown, nymph, larva) (Filippova 2008).

***Ixodes stromi* Filippova, 1957**

Ixodes stromi Filippova, 1957: 864.

Recorded hosts. Mammalia: *Alticola argentatus* (Severtzov) (silver mountain vole), *Apodemus agrarius* (striped field mouse), *Craseomys rufocanus* (grey red-backed vole), *Crocidura sp.* (shrew), *Lasiopodomys gregalis* (narrow-headed vole), *Microtus arvalis* (common vole), *Mustela sp.* (weasel), *Myodes centralis* (Miller) (Tien Shan red-backed vole), *Nothocricetulus migratorius* (grey dwarf hamster), *Ochotona macrotis* (Günther) (large-eared pika), *Rattus pyctoris* (Turkestan rat) (Filippova 1977).

Recorded locations (Fig. 20). Russia: Western Sayan (Arumova and Dineva 1973). **Kazakhstan:** Tarbagatai Mountains (Afanas'eva 1959), Dzungarian Alatau (Ushakova and Fedosenko 1963; Ushakova et al. 1976), Trans-Ili Alatau (Ushakova and Fedosenko 1963). **Kyrgyzstan:** Kyrgyz Ala-Too Range (Fedorova 2012b), Terskey Alatau (Fedorova 2012b), Chuy Valley – found in 1966 (Grebenyuk 1966), was not found in the same territories in 2018 (Fedorova 2021). **Tajikistan:** Peter the First Range (Filippova 1977), Varzob gorge (Sosnina 1954 – here *I. stromi* was incorrectly identified as *I. trianguliceps* because the new species was described by Filippova in 1957b).

Ecology and other information. *Ixodes stromi* is a tick species only indigenous to southern Siberia in Russia (Tsapko 2020). The main part of its distribution spans in Kazakhstan and Middle Asia. In all territories of its range,

Figure 20. Map of Russia and neighboring countries showing the locations where *Ixodes stromi* was reported.

it is confined to the forest-meadow and forest-steppe belt of medium-altitude mountains, to stony and rocky habitats, which are insolated and, therefore, have a warmer microclimate (Filippova 1967).

This species is nidicolous and uses rodents, shrews, and small carnivores as hosts at all stages. It is considered a rare species reaching small individual number (Filippova 1977).

The type specimens of *I. stromi* are known from Kyrgyzstan and stored at the Zoological Institute of the Russian Academy of Sciences: the lectotype: the nymph; Kyrgyzstan, Tien Shan, Kungei Ala Tau Mt. Range, Ch-Aksu Canyon, talus, from *Clethrionomys frater* (synonym of *Myodes centralis*), 11.VIII.1953, coll. N.A. Filippova; AL I78. The paralectotypes: 6 larvae; FBM I586, I876; 6 larvae; FBM I873, I875. Description – Filippova 1977: 122–127 (female, nymph, larva; male unknown) (Filippova 2008).

Subgenus *Monoixodes* Emelyanova & Kozlovskaya, 1967: 489.

***Ixodes maslovi* Emelyanova & Kozlovskaya, 1967**

Ixodes maslovi Emelyanova & Kozlovskaya, 1967: 489.

Recorded hosts. To date hosts of this tick species are unknown (Guglielmone et al. 2014).

Recorded locations (Fig. 21). Russia: Khabarovsk Krai – Khekhtsir Range and the rural locality Vyatskoye (Emelyanova and Kozlovskaya 1967); Krasnoyarsk Krai – Kozulsky District, the village Bolshoy Kemchug (Voltsyt 1997).

Ecology and other information. *Ixodes maslovi* is an almost unstudied tick known and described from two findings of its male and female (Emelyanova and Kozlovskaya 1967), as well as the nymph (Voltsyt 1997).

Figure 21. Map of Russia and neighboring countries showing the locations where *Ixodes maslovi* was reported.

Camicas et al. (1998) and Kolonin (2009) regard *I. maslovi* as an abnormal form of *I. persulcatus* although Filippova (1977) and Guglielmone et al. (2020) consider *I. maslovi* a valid taxon.

The type specimens are deposited at the Zoological Institute of the Russian Academy of Sciences – the holotype: male; [Russia], environs of Khabarovsk, Khekhtsir Mt. Range, 12.VI.1964, collected from vegetation by O.L. Kozlovskaya; FBM I1412; the paratype: female; FBM I1413. Description – Filippova 1977: 248–251 (female, male); Voltsit 1997: 265–268 (nymph; larva unknown) (Filippova 2008).

Subgenus *Pholeoixodes* Schulze, 1942: 630.

***Ixodes arboricola* Schulze & Schlottke, 1929**

Ixodes arboricola Schulze & Schlottke: Morel and Pérez 1973: 275.
Ixodes arboricola muscicapae Schulze, 1930: 3; Haarløv 1962: 425.
Ixodes strigicola Schulze & Schlottke: Haarløv 1962: 425.
Ixodes dryadis Schulze & Schlottke: Haarløv 1962: 425.
Ixodes passericola Schulze: Haarløv 1962: 425.
Ixodes arboricola bogatschevi Kirshenblat, 1936: 93; Haarløv 1962: 425.
Ixodes lagodechiensis Dzhaparidze, 1950: 117; Kolonin 1981: 84.

Recorded hosts. Aves: *Accipiter gentilis* (Linnaeus) (northern goshawk), *Acrocephalus scirpaceus* (Hermann) (Eurasian reed warbler), *Aegithalos caudatus* (Linnaeus) (long-tailed tit), *Aegolius funereus* (Linnaeus) (boreal owl), *Athene noctua* (little owl), *Certhia brachydactyla* Brehm (short-toed treecreeper), *Certhia familiaris* Linnaeus (Eurasian treecreeper), *Chloris chloris* (European greenfinch), *Coloeus monedula* (Linnaeus) (western jackdaw), *Columba palumbus* Linnaeus (common wood pigeon), *Coracias garrulus* Linnaeus (European roller), *Corvus frugilegus* Linnaeus (rook), *Curruca communis* (common whitethroat), *Cyanistes caeruleus* (Linnaeus) (Eurasian blue tit), *Dendrocopos major* (great spotted woodpecker), *Emberiza citrinella* (yellowhammer), *Erithacus rubecula* (European robin), *Falco peregrinus* Tunstall (peregrine falcon), *Falco tinnunculus* Linnaeus (common kestrel), *Ficedula albicollis* (Temminck) (collared flycatcher), *Ficedula hypoleuca* (European pied flycatcher), *Garrulus glandarius* (Eurasian jay), *Glaucidium passerinum* (Linnaeus) (Eurasian pygmy owl), *Hirundo rustica* Linnaeus (barn swallow), *Lophophanes cristatus* (Linnaeus) (crested tit), *Motacilla alba* (white wagtail), *Muscicapa striata* (Pallas) (spotted flycatcher), *Parus major* (great tit), *Passer domesticus* (house sparrow), *Passer montanus* (Eurasian tree sparrow), *Periparus ater* (Linnaeus) (coal tit), *Phoenicurus ochruros* (Gmelin) (black redstart), *Phoenicurus phoenicurus* (common redstart), *Phylloscopus trochilus* (Linnaeus) (willow warbler), *Picus canus* Gmelin (grey-headed woodpecker), *Poecile montanus* (Conrad von Baldenstein) (willow tit), *Poecile palustris* (Linnaeus) (marsh tit), *Pyrrhula pyrrhula* (Linnaeus) (Eurasian bullfinch), *Remiz pendulinus* (Linnaeus) (Eurasian penduline tit), *Riparia riparia* (Linnaeus) (sand martin), *Serinus serinus* (Linnaeus) (European serin), *Sitta europaea* (Eurasian nuthatch) (Filippova 1977; Keve et al. 2022), western rock nuthatch *Sitta neumayer* Michahelles (Ogandzhanyan 1984), *Spinus spinus* (Linnaeus) (Eurasian siskin), *Strix aluco* Linnaeus (tawny owl), *Sturnus vulgaris* (common starling), *Troglodytes troglodytes* (Linnaeus) (Eurasian wren),

Figure 22. Map of Russia and neighboring countries showing the locations where *Ixodes arboricola* was reported.

Turdus merula (common blackbird), *Turdus philomelos* (song thrush), *Tyto alba* (Scopoli) (barn owl), *Upupa epops* Linnaeus (Eurasian hoopoe) (Filippova 1977; Keve et al. 2022).

Recorded locations (Fig. 22). Russia: Southern Primorskyi Krai (Pogranichny District, Vladivostok, Nakhodka, Putyatin Island) (Emelyanova and Gordeeva 1969; Emelyanova 1972; Bolotin 2000). **Ukraine:** outskirts of Kyiv (Nebogatkin 2014), Dnipropetrovsk Oblast (the rural locality Andriivka), Crimea (Olenivka and Alushta) (Filippova 1977). **Belarus:** Białowieża Forest, Minsk, Gomel Oblast (the village Markovskoye) (Gembetsky 1966, 1972). **Armenia:** Syunik Province (former Goris Province) (Ogandzhanyan 1984). **Azerbaijan:** Karabakh (Kirschenblatt 1936). **Georgia:** Lagodekhi Nature Reserve (Djaparidze 1960). **Kyrgyzstan** (Fedorova 2012a).

Ecology and other information. *Ixodes arboricola* is an endophilic parasite, mainly of birds from ecological groups nesting in tree holes and nest boxes and also even in ground burrows (Filippova 1977). Also, certain cases of this species infesting bats in tree holes have been recorded (Arthur 1963).

The interesting feature of its distribution is the disjunctivity, which is confirmed by the discovery of this species in the areas quite distant from each other – western and central Europe, North Africa, Transcaucasia, western Asia, and the Far East in Russia (Estrada-Peña et al. 2018) and China (Chen et al. 2010).

Ixodes cornutus Lotozky, 1956

Ixodes cornutus Lototsky, 1956: 27.
Ixodes rugicollis Schulze & Schlottke: Morel and Aubert 1975: 99.

Recorded hosts. Mammalia: *Mustela erminea* Linnaeus (stoat) (Filippova 1977).

Figure 23. Map of Russia and neighboring countries showing the locations where *Ixodes cornutus* was reported.

Recorded locations (Fig. 23). Tajikistan: Peter the First Range, the source of the Divansu River, close to the Oshanin glacier (Filippova 1977).

Ecology and other information. *Ixodes cornutus* is a species described from two identical females (Lotozky 1956) that were found in Tajikistan, in the eastern part of Peter the First Range, by the source of the Divansu River (the basin of the Surkhob River), near the Oshanin glacier, on a stoat.

The type specimen of *I. cornutus* is deposited at the Zoological Institute of the Russian Academy of Sciences (Lotozky 1956: 27). Lectotype: female; 38 [Tajikistan, the Peter the First Mt. Range], the source of the Divansu River, the ancient moraine of the Oshanin glacier, *Mustela erminea*, ad.; male; 4.VII.1954; AL I845. Description – Filippova 1977: 178 (female; male, nymph, larva unknown) (Filippova 2008).

Ixodes crenulatus Koch, 1844

Ixodes crenulatus Koch, 1844c: 39; Morel and Pérez 1973: 275.

Note. Tick names are used sensu Guglielmone et al. (2014) in this review. Thus, this species is not synonymous with *I. canisuga* Johnston as suggested by Filippova (1977) based on their morphological similarities and because the latter is not known to occur in Russia. *Ixodes crenulatus* was erroneously synonymized with *I. kaiseri* Arthur (Sonenshine et al. 1969), as clarified later (Filippova and Uspenskaya 1973).

Recorded hosts. Mammalia: *Allactaga major* (Kerr) (great jerboa), *Allactaga sibirica* (Forster) (Mongolian five-toed jerboa), *Allocricetulus eversmanni* (Brandt) (Eversmann's hamster), *Apodemus sylvaticus* (wood mouse), *Canis aureus* Linnaeus (golden jackal), *Canis familiaris* (domestic dog), *Canis lupus* Linnaeus (gray wolf), *Cricetulus barabensis* (Pallas) (Chinese striped hamster),

Ellobius talpinus (northern mole vole), *Erinaceus europaeus* (European hedgehog), *Felis catus* Linnaeus (domestic cat), *Felis lybica* Forster (African wildcat), *Hemiechinus auratus* (long-eared hedgehog), *Homo sapiens* Linnaeus (human), *Lasiopodomys gregalis* (narrow-headed vole), *Lepus tolai* (tolai hare), *Marmota baibacina* (gray marmot), *Marmota bobak* (bobak marmot), *Marmota caudata* (Geoffroy) (long-tailed marmot), *Marmota kastschenkoi* Stroganov and Yudin (forest-steppe marmot), *Marmota menzbieri* (Kashkarov) (Menzbier's marmot), *Marmota sibirica* (Tarbagan marmot), *Meles meles* (Eurasian badger), *Microtus arvalis* (common vole), *Mustela eversmanii* (steppe polecat), *Mustela nivalis* (least weasel), *Myodes glareolus* (bank vole), *Myospalax myospalax* (Siberian zokor), *Nothocricetulus migratorius* (grey dwarf hamster), *Nyctereutes procyonoides* (Gray) (common raccoon dog), *Ochotona dauurica* (Pallas) (Daurian pika), *Ochotona pallasi* (Gray) (Pallas's pika), *Otocolobus manul* (Pallas) (Pallas's cat), *Ovis aries* (domestic sheep), *Phodopus sungorus* (Pallas) (winter white dwarf hamster), *Procyon lotor* (Linnaeus) (raccoon), *Spermophilus dauricus* Brandt (Daurian ground squirrel), *Spermophilus pygmaeus* (little ground squirrel), *Spermophilus relictus* (Kashkarov) (relict ground squirrel), *Spermophilus suslicus* (speckled ground squirrel), *Vulpes corsac* (corsac fox), *Vulpes vulpes* (red fox) (Filippova 1977; Litvinov and Sapegina 2003; Kalyagin et al. 2005, 2008).

Aves: *Emberiza cia* Linnaeus (rock bunting), *Oenanthe isabellina* (isabelline wheatear) (Filippova 1977).

Recorded locations (Fig. 24). Russia: Tula Oblast (Myasnikov and Katelina 1964), Kursk Oblast (Lgovsky District), Voronezh Oblast (Kamennaya Steppe Nature reserve), Rostov Oblast (Aksay), Republic of Kalmykia (Derbetovsky District, Sarpinsky District), Volgograd Oblast (Gorodishchensky, Derbetovsky and Sarpinsky District) (Denisov 2010, 2019), Kabardino-Balkaria

Figure 24. Map of Russia and neighboring countries showing the locations where *Ixodes crenulatus* was reported.

(tract Khaimasha) (Bittirova et al. 2019), Dagestan (Aliev et al. 2007), Astrakhan Oblast, Stavropol Krai (Filippova 1977), Saratov Oblast (Turtseva 2007; Denisov 2010, 2019; Porshakov et al. 2020), Yekaterinburg (Milintsevich et al. 2016), Tyumen Oblast (Glazunov and Zotova 2014), Kurgan Oblast (Starikov and Starikova 2021), Novosibirsk Oblast (Suzunsky, Karasuksky and Maslyaninsky District) (Davydova and Lukin 1969), Omsk Oblast (Tarasevich et al. 1971), Kemerovo Oblast (Kalyagin et al. 2005, 2008; Kovalevsky et al. 2018); Altai Krai (Oberth et al. 2015) (Sovetsky District, the village Kokshi) (Filippova 1977), Altai Republic (Shebalinsky District, the village Cherga) (Litvinov and Sapegina 2003), Tuva (Glazunov and Zotova 2014; Filippova 1977), Transbaikal (villages Borgoy, Kyakhta, Selenge and Borzinsky District) (Filippova 1977); Amur Oblast (village Krasny Vostok), Southern Outer Manchuria (Khankaysky District (Kolonin 1986; Bolotin 2000). **Ukraine:** outskirts of Kyiv (Akimov and Nebogatkin 2016), Zakarpattia Oblast and Western Ukraine in general (Podobivskyi and Fedonyuk 2017), Cherkasy Oblast, Dnipropetrovsk Oblast, Askania-Nova Nature Reserve, Striltsivskyi Steppe Nature Reserve, Kharkiv Oblast (Tokarsky and Zorya 2007), Lugansk Oblast (Kuznetsov and Bondarev 2007) (including Khomutovs'kyi Steppe) (Filippova 1977), the north-western sea coast of the Black Sea (Rusev 2009), Crimea (Evstafiev 2017) – plain and mountainous lands (Filippova 1977). **Belarus:** Viciebsk Voblasts (Subbotina and Osmolovsky 2022), Białowieża Forest (Filippova 1977), considered rare (Bychkova et al. 2015). **Moldova:** Lozova, Ivancea, Leova, reedbeds of the low Dniester and Pruth (Filippova 1977; Uspenskaya et al. 2006). **Georgia:** Samegrelo-Zemo Svaneti, Imereti (Sukhiashvili et al. 2020). **Armenia:** Aragats mountain range (Dilbaryan and Poghosyan 2018). **Kazakhstan:** through the whole territory of Kazakhstan (Filippova 1977) and plus recent findings in the next regions: West Kazakhstan Region (Tanitovsky and Maikanov 2018), Almaty Region (Bibikov and Bibikova 2010), Pavlodar Region (Amirova et al. 1989), the north of Betpak-Dala (Rapoport et al. 2017), Jambyl Region (Kyrgyz Ala-Too Range, Talas Alatau) (Sarsenbaeva et al. 2016). **Kyrgyzstan:** Tian Shan in general (Abdikarimov et al. 2018) and its certain ranges and valleys including Kyrgyz Ala-Too Range (Akyshova et al. 2022) and Terskey Ala-too Range (Fedorova 2012b); Chuy Valley (Fedorova 2021). **Turkmenistan:** Krasnovodsk Peninsula, Daşoguz, the foothills of The Köpet Dag, Badhyz State Nature Reserve, Karakum Desert (Kochkareva et al. 1971), Serhetabat (former Kushka) (Filippova 1977). **Uzbekistan:** Tashkent Region (Muratbekov 1954). **Tajikistan:** outskirts of the rural locality Jilikul (Filippova 1977), Tigrovaya Balka (Manilova and Shakhmatov 2008).

Ecology and other information. *Ixodes crenulatus* is among the tick species that have the most extensive ranges comparing to other representatives of its family within Russia (Tsapko 2020).

It is a typical nidicolous parasite of mammals and in the Asian part of its range as the main hosts it uses species of marmots of the genus *Marmota* (with a predominance of gray marmot) and such representatives of predatory mammals as badgers, steppe polecats, red and corsac foxes. The composition of the main host spectrum from different orders (rodents and predatory mammals) finds an explanation in close connections of topical and trophic relationships of marmots and predators. All of them have burrows of medium diameter, complex design, with a nesting chamber, remote from the entrance, which

provides the stability of the microclimate, where ticks find suitable conditions. The above species of carnivores often use the burrows of their prey, marmots, and small carnivores, facilitating the exchange of ticks not only between individual burrows, but also between remote host settlements (Filippova 2011).

This tick species is considered rare, for example, only few findings were mentioned in the Astrakhan Oblast (Zimina et al. 1965; Zimina et al. 1996) and Saratov Oblast (Denisov 2019). In most of the recognized range, *I. crenulatus* coexists with the closely related *I. kaiseri*. These species not only inhabit the same territory and the same biotopes but can also parasitize one host individual at the same time (Tsapko 2017). Therefore, it is necessary to consider that accurate identification of these species is required and there is always a chance of their misidentification.

According to some suggestions (Emelyanova 1979), *I. crenulatus* is probably a species group, or at least has remarkable intraspecific variations involving morphotypes (Filippova and Panova 2000).

Ixodes hexagonus Leach, 1815

Ixodes hexagonus Leach, 1815: 397; Morel and Pérez 1973: 275.
Ixodes autumnalis Leach: Neumann 1911: 17.
Ixodes erinacei Audouin: Neumann 1911: 17.
Ixodes auricularis Robineau-Desvoidy: Morel and Pérez 1973: 275.
Ixodes sexpunctatus Koch: Neumann 1911: 17.
Ixodes vulpis Pagenstecher: Neumann 1911: 17.
Ixodes erinaceus Audouin: Neumann 1911: 17.

Recorded hosts. Mammalia: *Bos taurus* Linnaeus (cattle), *Canis familiaris* (domestic dog), *Erinaceus europaeus* (European hedgehog), *Felis catus* (domestic cat), *Lutra lutra* (Linnaeus) (Eurasian otter), *Meles meles* (Eurasian badger), *Mustela erminea* (stoat), *Mustela nivalis* (least weasel), *Mustela putorius* Linnaeus (European polecat), *Oryctolagus cuniculus* (Linnaeus) (European rabbit), *Ovis aries* (sheep), *Rattus norvegicus* (brown rat), *Vulpes vulpes* (red fox) (Filippova 1977).

Aves: *Turdus merula* (common blackbird) (Filippova 1977).

Recorded locations (Fig. 25). Ukraine: outskirts of Kyiv, Khmelnytskyi Oblast (Levytska et al. 2021), the North-Western seacoast of the Black Sea (Rusev 2009), Zakarpattia Oblast (the rural locality Malyi Berezny) (Filippova 1961).

Ecology and other information. *Ixodes hexagonus* is a typical nidicolous parasite of carnivores and hedgehogs. It has certain morphological similarities to *I. crenulatus* and *I. kaiseri* and has common sympatric zones with this species along its range (Filippova 1999). Ukraine is the only country of the former Soviet Union, on the territory of which this European species is present in the tick fauna (Filippova 1977). In general *I. hexagonus* was detected quite rarely in Ukraine, and almost always in the west of Ukraine and mainly from hedgehogs (Kolonin 2009). Akimov and Nebogatkin (2016) assumed that it can be found in the vicinity of Kyiv, and eventually it was confirmed by Levytska et al. (2021). Rare occasional human bites have been recorded (Rosický and Weiser 1952; Arthur 1963; Bursali et al. 2012).

Figure 25. Map of Russia and neighboring countries showing the locations where *Ixodes hexagonus* was reported.

Ixodes kaiseri Arthur, 1957

Ixodes kaiseri Arthur, 1957: 578; Morel and Aubert 1975: 99.
Ixodes bakonyensis Babos: Morel and Aubert 1975: 99.
Ixodes vulpinus Babos: Morel and Aubert 1975: 99.

Recorded hosts. Mammalia: *Canis familiaris* (domestic dog), *Erinaceus concolor* Martin (southern white-breasted hedgehog), *Erinaceus europaeus* (European hedgehog), *Erinaceus roumanicus* Barrett-Hamilton (northern white-breasted hedgehog), *Felis chaus* Schreber (jungle cat), *Felis lybica* (African wildcat), *Hyaena hyaena* (Linnaeus) (striped hyena), *Hystrix indica* Kerr (Indian crested porcupine), *Lepus europaeus* (brown hare), *Mustela eversmanii* (steppe polecat), *Meles meles* (Eurasian badger), *Nyctereutes procyonoides* (common raccoon dog), *Vulpes corsac* (corsac fox), *Vulpes vulpes* (red fox) (Filippova 1977; Tsapko 2017).

Recorded locations (Fig. 26). Russia: southwestern peripheries of the Central Russian Upland and also Rostov Oblast (Khametova et al. 2018) and Stavropol Krai (Tsapko 2017) and the North Caucasus – the outskirts of Grozny (Chechnya) (Filippova 1977, 1999; Tsapko 2017, 2020) and Nogaysky District (Dagestan) (Tsapko 2017). **Ukraine:** outskirts of Kyiv (Akimov and Nebogatkin 2016) and the south of Ukraine, in particular Askania-Nova Nature Reserve (Filippova 1977), the North-Western seacoast of the Black Sea (Matyukhin 2017), Crimea (Filippova 1977). **Moldova:** Lozova, Ivancea, Doibani, Leova, Etulia, reedbeds of the low Dniester and Pruth (Filippova 1977; Uspenskaya et al. 2006). **Georgia:** the outskirts of Tbilisi, Lagodekhi Nature Reserve (Filippova 1977), Eldari Steppe (Tsapko 2017). **Armenia:** Gegharkunik Province (rural locality Geghamashen) (Tsapko 2017), Aragats

Figure 26. Map of Russia and neighboring countries showing the locations where *Ixodes kaiseri* was reported.

mountain range (Dilbaryan and Poghosyan 2018). **Azerbaijan:** Mil plain (Filippova and Uspenskaya 1973), Beylagan District, Zangilan District, Aghjabadi District, Martuni Province, Shaki District (Tsapko 2017). **Kazakhstan:** West Kazakhstan Region, Dzungarian Alatau – outskirts of the rural locality Topolëvka and the Koksu district (Ushakova et al. 1976; Filippova 1999). **Kyrgyzstan** (Fedorova 2012b).

Ecology and other information. *Ixodes kaiseri* is a typical nidicolous parasite of carnivores and also hedgehogs and porcupines which is morphologically very similar to *I. crenulatus* and has common sympatric zones with this species along its range (Filippova 1999). Its range itself is patchy and disjunctive areas of sympatry for both of these species are found in southeastern Europe - Romania, Moldova, Ukraine, including the Crimean Peninsula as well as in Russia - the southwestern extremities of the Central Russian Upland and the Northern Caucasus; then after a long gap - in Western Kazakhstan and again after a big gap - in the Dzungarian Alatau (Filippova 1999). Judging by literature, it is also known from Egypt and Israel (Arthur 1957, 1960, 1965). As Filippova and Uspenskaya (1973) assumed, its distribution in the Middle East and also other parts of Asia can be wider than it is known at present, which was already confirmed by the findings of this tick species in Turkey (Orkun and Karaer 2018) and Xinjiang in China (Zhao et al. 2019) near the border with Kazakhstan and the Dzungarian Alatau and hence, it is possible that the sympatry of these two species is more widespread. This is also supported by literature data, because until the 1970s in the territory of the former USSR *I. kaiseri* was not differentiated from *I. hexagonus* and *I. crenulatus* (Emelyanova 1979; Filippova 1999).

These species not only inhabit the same territory and inhabit the same biotopes in some places but can also parasitize one host individual at the same time (Tsapko 2017). It is also important to note that according to Filippova's

opinion (1999), the territorial signs of the ranges of these two species, their biotope and host-parasite relationships indicate that the range of *I. crenulatus* (which is predominantly connected with marmots and their burrows in steppe and forest-steppe zones) over the most part of its distribution has a Central Asian origin, while the range of *I. kaiseri* (mainly the parasite of carnivores and occurring in their burrows) is supposedly of European origin.

Ixodes lividus Koch, 1844

Ixodes lividus Koch, 1844: 234; Morel and Pérez 1973: 275.
Ixodes bavaricus Schulze & Schlottke, 1929: 95.
Ixodes plumbeus bavaricus Schulze & Schlottke: Morel and Pérez 1973: 275.
Ixodes plumbeus obotriticus Schulze & Schlottke: Morel and Pérez 1973: 275.
Ixodes (*Pholeoixodes*) *hirundinicola* Schulze: Kolonin 1981: 19.

Recorded hosts. Aves: *Alauda arvensis* (Eurasian skylark), *Delichon urbicum* (Linnaeus) (common house martin), *Merops apiaster* Linnaeus (European bee-eater), *Passer domesticus* (house sparrow), *Passer montanus* (Eurasian tree sparrow), *Riparia diluta* (Sharpe & Wyatt) (pale martin), *Riparia riparia* (sand martin) (Filippova 1977; Tagiltsev et al. 1984; Rusev 2009; Bolshakova et al. 2019; Kovalevsky et al. 2019).

Mammalia: *Mus musculus* (house mouse) (Filippova 1977).

Recorded locations (Fig. 27). Russia: Curonian Spit (Kaliningrad Oblast) (Filippova 1961), Karelia (Bobrovskikh 1979), Leningrad Oblast, (Zolotov and Buker 1976), Moscow Oblast (Glashchinskaya-Babenko 1956), Ryazan Oblast (Filippova 1977), Ivanovo Oblast (Mayorova 2004), Saratov Oblast (Korneev

Figure 27. Map of Russia and neighboring countries showing the locations where *Ixodes lividus* was reported.

et al. 2018), Kuybyshev Reservoir (Republic of Tatartstan) (Lvov et al. 2014), Voronezh Oblast (Gaponov and Tewelde 2021), Tymen Oblast (Starikov et al. 2017b), Kurgan Oblast (Starikov and Starikova 2021), Omsk Oblast (Tagiltsev et al. 1984; Yakimenko et al. 1991), Tomsk Oblast, Kemerovo Oblast (Kovalevsky et al. 2019), Novosibirsk Oblast (Yakimenko et al. 2013), Irkutsk Oblast (Danchinova et al. 2007), Ikatsky Ridge (Republic of Buryatia), Zabaykalsky Krai (Emelyanova et al. 1963), Republic of Tuva (Kholodilov et al. 2019), Sakha (Yakutia) (Shadrina et al. 2011), Khabarovsk Krai (Volkov and Chernykh 1977). **Ukraine:** Zakarpattia Oblast, Kaniv Nature Reserve (Cherkasy Oblast), (Emchuk 1960), Danube Biosphere Nature Reserve (Odesa Oblast) (Emchuk 1960; Didyk 2013), Kyiv (Akimov and Nebogatkin 2002), delta of the Dniestr River (Rusev 2009). **Belarus:** Gomel Region, Minsk Region (Gembetsky 1972). **Moldova:** banks of the Dniestr River (Movila et al. 2008). **Kazakhstan:** Atyrau Region (Pomerantsev 1950; Levit 1957), Kostanay Region (Makhmetov 1961), Pavlodar Region (Amirova et al. 1989), Akmola Region (Filippova 1961; Ushakova 1962).

Ecology and other information. *Ixodes lividus* is a specific nidicolous ectoparasite of the sand martin, *Riparia riparia*. Also, it has been collected from birds and house mice which occasionally could visit sand martin's nests such as house sparrows and common house martins.

Due to the wide distribution of its main host, this tick species also occurs in a vast geographical range and can be characterized by having a trans-Palearctic distribution. The locations of findings in Russia and the neighboring countries listed above reflect the general pattern of its distribution on a map so we can suppose that this tick can be found in the north of the Palearctic almost everywhere in habitats of the sand martin.

Ixodes prokopjevi (Emel´yanova, 1979)

Pholeoixodes prokopjevi Emel'yanova, 1979: 14.

Recorded hosts. Mammalia: Daurian hedgehog *Mesechinus dauuricus* (Sundevall) (Emelyanova 1979).

Recorded locations (Fig. 28). Russia: Transbaikal (Emelyanova 1979).

Ecology and other information. *Ixodes prokopjevi* is an extremely poorly studied tick species initially described based on the male holotype from steppes of north-eastern Mongolia; its paratypes, larvae and nymphs, are noted as originating from the outskirts of the lake Baruun Shavart Nuur in Eastern Mongolia, as well as females and nymphs from the south-eastern Transbaikal without any indications of certain points of findings (Emelyanova 1979).

Kolonin (2009) states that this species should be considered a synonym of *I. crenulatus* but Guglielmone et al. (2010, 2014) recognize it as a valid species.

The Daurian hedgehog was recorded as a host, but we can assume that carnivores, lagomorphs, and rodents are also hosts of this tick species, as in case of *I. crenulatus*, another representative of the subgenus *Pholeoixodes* and the most similar species to this tick. The distribution area and ecology of *I. prokopjevi*, as well host-parasite relationships and their role in transmission of vector-borne infections remain unknown.

Figure 28. Map of Russia and neighboring countries showing the locations where *Ixodes prokopjevi* was reported.

Ixodes subterraneus Filippova, 1961

Ixodes subterranus Filippova, 1961: 226. Morel and Pérez 1973: 275.
Pholeoixodes arboricola koshkinae Emel'yanova: Kolonin 1981: 20.
Pholeoixodes arboricola deserta Emel'yanova: Kolonin 1981: 20.

Recorded hosts. Aves: *Athene noctua* (little owl), *Carduelis carduelis* (European goldfinch), *Coracias garrulus* (European roller), *Coturnix coturnix* (common quail), *Galerida cristata* (crested lark), *Falco naumanni* Fleischer (lesser kestrel), *Oenanthe hispanica* (western black-eared wheatear), *Oenanthe isabellina* (isabelline wheatear), *Oenanthe oenanthe* (northern wheatear), *Parus major* (great tit), *Passer ammodendri* Gould (saxaul sparrow), *Passer domesticus* (house sparrow), *Passer montanus* (Eurasian tree sparrow), *Pastor roseus* (rosy starling), *Petronia petronia* (rock sparrow), *Pica pica* (Eurasian magpie), *Sturnus vulgaris* (common starling), *Turdus ruficollis* (red-throated thrush) (Filippova 1977).

Recorded locations (Fig. 29). Russia: Transbikalia (Barguzin Valley, Cape Ryty) (Emelyanova 1972, as *I. arboricola*). **Kazakhstan:** Mangyshlak Peninsula (Maslennikova and Ushakova 1971), Jambyl Region (Kokuzek), Trans-Ili Alatau, Syugaty Valley (Maslennikova and Stogov 1974), Almaty Region (lower reaches of the Ili River) (Ushakova 1958, as *Ixodes* sp.), Dzungarian Alatau (Ushakova et al. 1976). **Kyrgyzstan:** Jalal-Abad Region (Bazar-Korgon District), the valley of the river Naryn (Grebenyuk 1966). **Turkmenistan:** Krasnovodsk plateau, outskirts of Geok Tepe, Kara Kala, Ashgabat, Tejen, Baýramaly, highland Badhyz (Filippova 1961; Kochkareva et al. 1971; Scherbinina 1973). **Tajikistan:** southern spurs of the Hisar Range – the vicinity of Hisar (Filippova 1977).

Ecology and other information. *Ixodes subterraneus* is a parasite of birds nesting in ground burrows (Filippova 1977). The main part of its distribution

Figure 29. Map of Russia and neighboring countries showing the locations where *Ixodes subterraneus* was reported.

lies in Kazakhstan and Middle Asia, the lesser part in Transbaikalia (Russia) (Filippova 1977). This tick species can be found in foothill dry steppes, as well as near and in deserts. This species was originally named *I. subterranus* in Filippova (1961) but amended to *I. subterraneus* in Filippova (1977).

Subgenus *Scaphixodes* Schulze, 1941: 491

***Ixodes berlesei* Birula, 1895**

Ixodes berlesei Birula, 1895: 353.

Recorded hosts. Aves: *Apus pacificus* (Latham) (Pacific swift), *Corvus frugilegus* Linnaeus (rook), *Falco rusticolus* Linnaeus (gyrfalcon), *Falco tinnunculus* Linnaeus (common kestrel), *Monticola solitarius* (blue rock thrush), *Montifringilla nivalis* (Linnaeus) (white-winged snowfinch), *Phoenicurus erythrogastrus* (Güldenstädt) (Güldenstädt's redstart), *Phoenicurus ochruros* (black redstart), *Phoenicurus erythronotus* (Eversmann's redstart), *Plectrophenax nivalis* (Linnaeus) (snow bunting), *Prunella collaris* (Scopoli) (alpine accentor), *Sturnus vulgaris* (common starling), *Tichodroma muraria* (Linnaeus) (wallcreeper) (Filippova 1977; Voltsyt 1997).

Recorded locations (Fig. 30). Russia: Dagestan (Filippova 1977), Western Siberia – Salair Ridge, Kuznetsk Alatau (Chunihin 1967), Eastern Siberia – banks of the Angara River (Birula 1895) and Buryatia (Ikatsky Ridge) (Emelyanova et al. 1963), Bering Island (Voltsyt 1997). **Kazakhstan:** Trans-Ili Alatau (Grebenyuk 1966). **Kyrgyzstan:** Aksay Valley (Grebenyuk 1966). **Turkmenistan:** outskirts of Ashgabad (Filippova 1977). **Tajikistan:** Hisar Range, Varzob gorge (Ivanov 1945; Lotozky 1945).

Ecology and other information. *Ixodes berlesei* is a little studied nidicolous tick occurring in the Greater Caucasus, as well as in Middle Asia and Siberia.

Figure 30. Map of Russia and neighboring countries showing the locations where *Ixodes berlesei* was reported.

There is one report about a finding of this tick on the Bering Island belonging to the Commander Islands in the Bering Sea, a female and three larvae collected 26 August 1990 from a snow bunting and deposited at the collection of the Zoological Museum of Moscow State University (Voltsyt 1997). The author states that the date of the tick collection indicates the presence of a permanent population of this species on the island because in the end of August birds usually already are prepared for the autumn migration after the breeding period, and, therefore, ticks could not have been transported there from the continent. Hence, we could assume that probably the real distribution of this tick is much wider and includes mountainous areas not only in a warmer and temperate climate but also in cooler tundra and other climatically similar landscapes. The snow bunting as a host of this species also was registered for the first time. Overall, its hosts include birds nesting usually in rocks and feeding on the ground and during the flight (Filippova 1977).

The type specimen is deposited at the Zoological Institute of the Russian Academy of Sciences - holotype: female; 683, [Russia, Siberia] Angara, 1867, Chekanovskii, type; AL I528. Description – Filippova 1977: 230–236 (female, nymph, larva; male unknown) (Filippova 2008).

Ixodes caledonicus Nuttall, 1910

Ixodes caledonicus Nuttall, 1910: Nuttall 1910: 408.
Ixodes caledonicus sculpturatus Schulze, 1929: 60; Arthur 1963: 53.
Ixodes gussevi Reznik, 1958: 457; Filippova and Panova 1975: 339.

Recorded hosts. Aves: *Apus pacificus* (Pacific swift), *Corvus corax* Linnaeus (common raven), *Corvus cornix* (hooded crow), *Columba livia* (common pigeon),

Figure 31. Map of Russia and neighboring countries showing the locations where *Ixodes caledonicus* was reported.

Coloeus monedula (western jackdaw), *Falco peregrinus* (peregrine falcon), *Monticola solitarius* (blue rock thrush), *Oenanthe oenanthe* (Northern wheatear), *Petronia petronia* (rock sparrow), *Phoenicurus* sp. (redstart), *Tachymarptis melba* (Linnaeus) (Alpine swift) (Filippova 1977; Bolotin and Kolonin 1979).

Recorded locations (Fig. 31). Russia: valley of the Zerkalnaya River (Bolotin and Kolonin 1979). **Ukraine:** Crimean Peninsula, in particular the Tarkhankut Peninsula and the cape Kazantyp (Emchuk 1960; Filippova 1977). **Azerbaijan:** Qabala (Reznik 1958), Julfa (Filippova and Panova 1975). **Tajikistan:** Hisar Range (Filippova and Panova 1975).

Ecology and other information. *Ixodes caledonicus* is a little studied nidicolous tick species occurring in Europe as well as Western and Middle Asia. In Crimea this species is very rare and never has been found after 1980 (Nebogatkin 1998). Its hosts are birds that usually nest in rocks, feed on the ground, or feed and drink during flight (Filippova 1977).

Ixodes semenovi Olenev, 1929

Ixodes semenovi Olenev, 1929: 489.

Recorded hosts. Aves: *Prunella collaris* (alpine accentor), *Pyrrhocorax pyrrhocorax* (Linnaeus) (red-billed chough) (Filippova 1977).

Recorded locations (Fig. 32). Kazakhstan: Tian Shan – the northern slope of the Kyrgyz Ala-Too Range, the source of the river Merke (Jambyl Region) (Olenev 1929b). **Kyrgyzstan:** Terskey Ala-too Range (Grebenyuk 1961, 1966).

Ecology and other information. *Ixodes semenovi* is a very rare species in the post-Soviet territories known only from Kazakhstan and Kyrgyzstan, from

Figure 32. Map of Russia and neighboring countries showing the locations where *Ixodes semenovi* was reported.

the Tian Shan, where it inhabits rocks at an altitude of 2000 m a. s. l. (Filippova 1977). The type specimen of *I. semenovi* is deposited at the Zoological Institute of the Russian Academy of Sciences: the holotype - female; Mi[ddle] Asia, Aleksandrovskii Mt. Range [Kirgizskii Ala Tau], source of Merke River, Aral-Tyube, from *Accentor collaris*, 4.VII.1929, coll. I.A. Portenko; AL I549. Description – Filippova 1977: 219–223 (female, male, nymph; larva unknown) (Filippova 2008).

Ixodes signatus Birula, 1895

Ixodes signatus Birula, 1895: 353.
Ixodes arcticus Osborn: Cooley and Kohls 1945: 201.
Ixodes parvirostris Neumann: Neumann 1904: 444.
Ixodes eudyptidis v. signata Birula: Neumann 1911: 21.

Recorded hosts. Aves: *Phalacrocorax carbo* (Linnaeus) (great cormorant), *Urile pelagicus* (pelagic cormorant), *Urile penicillatus* (Brandt) (Brandt's cormorant), *Urile urile* (red-faced cormorant) (Filippova 1977).

Recorded locations (Fig. 33). Russia: islands: Furugelm Island, Tyuleniy Island, the Kuril Islands – Paramushir, Urup and Makanrushi, the Commander Islands – the Kamen Ariy and the Bering Island (Kirschenblatt 1936; Pomerantsev 1950; Violovich 1958, 1962a; Leonova et al. 1971; Timofeeva et al. 1971, 1974; Lvov et al. 2014b); mainland – Primorsky Krai (Lazovsky District) (Kozlovskaya el al. 1968).

Ecology and other information. *Ixodes signatus* is a nidicolous tick species occurring in several archipelagos and separate islands of the Russian Far East,

Figure 33. Map of Russia and neighboring countries showing the locations where *Ixodes signatus* was reported.

as well as in Japan and the west coast of North America together with the Pacific islands nearby (Filippova 1977). It inhabits mostly coastal rocks being an obligate parasite of cormorants. Other birds, for example the Siberian thrush *Geokichla sibirica* (Pallas), are considered occasional hosts (Violovich 1962a). Findings in the mainland Eurasia are probably occasional cases of transportation (Kozlovskaya et al. 1968).

The type specimens of *I. signatus* are deposited at the Zoological Institute of the Russian Academy of Sciences (Filippova 2008) and include the lectotype: female; [Aleut Islands], Unalashka, 1846, coll. Voznesenskii, type; AL I358; paralectotypes: 8 females, 1 nymph, AL I358a; 2 females; CB I3170, I3171. Description – Filippova 1977: 204–210 (female, male, nymph, larva).

Ixodes unicavatus Neumann, 1908

Ixodes unicavatus Neumann, 1908: 109; Schulze 1941: 491.
Ixodes tauricus Vshivkov & Filippova, 1957: 553; Gilot and Beaucournu 1973: 131.

Recorded hosts. Aves: *Gulosus aristotelis* (European shag) (Linnaeus) (Filippova 1977).

Recorded locations (Fig. 34). Ukraine: Crimean Peninsula, in particular the Tarkhankut Peninsula, The Kara Dag, the Kerch Peninsula, the cape Kazantyp (Emchuk 1960; Filippova 1977).

Ecology and other information. *Ixodes unicavatus* is an endophilic tick occurring in Europe primarily in coastal areas of the Atlantic Ocean and which can be found in its hosts' nests and under stones near them (Filippova 2007). It uses mostly cormorants - the European shag *Gulosus aristotelis* and the great

Figure 34. Map of Russia and neighboring countries showing the locations where *Ixodes unicavatus* was reported.

cormorant *Phalacrocorax carbo* as hosts (Schulze 1932; Arthur 1963; Guiguen et al. 1987; Kolonin 2008). In Crimea, this species has been known from a little number of specimens (Serdjukova 1956; Emchuk 1960).

Subgenus *Trichotoixodes* Reznik, 1961: 276.

***Ixodes brunneus* Koch, 1844**

Ixodes brunneus Koch, 1844a: 232.
Ixodes californicus Banks, 1904: Keirans and Clifford 1978: 54.
Ixodes kelloggi Nuttall & Warburton, 1907: Cooley and Kohls 1945: 205.

Recorded hosts. Aves: *Lanius collurio* (red-backed shrike) (Filippova 1977)

Recorded locations (Fig. 35). Ukraine: Crimea – Sudak City Municipality, the village Perevalivka (Filippova 1977).

Ecology and other information. *Ixodes brunneus* is a tick occurring mainly in the Americas being predominantly a parasite of passerine birds (Filippova 1977). The only record in Crimea on a red-backed shrike is considered a case of accidental introduction (Tsapko 2020).

***Ixodes frontalis* (Panzer, 1798)**

Acarus frontalis Panzer, 1798: 59, 23; Koch 1844a: 234.
Ixodes pallipes (Fabricius): Arthur 1963: 111.
Ixodes pari Leach, 1815: 399; Neumann 1911: 18.
Ixodes sturni Pagenstecher: Neumann 1901, 249.

Figure 35. Map of Russia and neighboring countries showing the locations where *Ixodes brunneus* was reported.

Ixodes avisugus Berlese: Neumann 1899: 107.
Ixodes apronatus Kirshenblat, 1934: 257; Arthur 1963: 111.
Ixodes sigalasi Lamontellerie, 1954: 561; Lamontellerie 1965: 87.

Recorded hosts. Aves: *Alectoris chukar* (chukar partridge), *Caprimulgus europaeus* Linnaeus (European nightjar), *Chloris chloris* (European greenfinch), *Corvus frugilegus* (rook), *Curruca communis* (common whitethroat), *Curruca curruca* (lesser whitethroat), *Erithacus rubecula* (European robin), *Falco tinnunculus* (common kestrel), *Fringilla coelebs* (Eurasian chaffinch), *Fringilla montifringilla* (brambling), *Garrulus glandarius* (Eurasian jay), *Hippolais icterina* (Vieillot) (icterine warbler), *Lanius collurio* (red-backed shrike), *Luscinia luscinia* (thrush nightingale), *Luscinia megarhynchos* (Brehm) (common nightingale), *Muscicapa striata* (spotted flycatcher), *Oenanthe hispanica* (western black-eared wheatear), *Oenanthe isabellina* (isabelline wheatear), *Parus major* (great tit), *Passer domesticus* (house sparrow), *Passer montanus* (Eurasian tree sparrow), *Petronia petronia* (rock sparrow), *Phoenicurus phoenicurus* (common redstart), *Phylloscopus trochilus* (willow warbler), *Phasianus colchicus* (common pheasant), *Pica pica* (Eurasian magpie), *Regulus regulus* (Linnaeus) (goldcrest), *Saxicola rubetra* (Linnaeus) (whinchat), *Streptopelia turtur* (Linnaeus) (European turtle dove), *Turdus iliacus* (redwing), *Turdus merula* (common blackbird), *Turdus philomelos* (song thrush), *Turdus torquatus* Linnaeus (ring ouzel), *Turdus viscivorus* (mistle thrush) (Filippova 1977).

Mammalia: *Meriones libycus* (Libyan jird) (Tsapko and Kotti 2017).

Recorded locations (Fig. 36). Russia: Kurgan Oblast – the rural locality Ketovo (Ruzsky 1929), Stavropol Krai (Reznik 1950; Guseva 1962; Tiflova et al. 1970), Krasnodar Krai; Chechnya (Marutyan 1963; Baisarova 2021), Dagestan (Gusev and Guseva 1960). **Ukraine:** Poltava Oblast (Olenev 1931a), Odesa Oblast, Mykolaiv Oblast, Kherson Oblast (Rusev 2009), Crimea (Filippova 1977). **Belarus:** Pripyatsky National Park (Tsvirko 2008). **Moldova:** Codru (Morozov et al. 2022),

Figure 36. Map of Russia and neighboring countries showing the locations where *Ixodes frontalis* was reported.

Olănești (Filippova 1977), Chishinau (Morozov and Proka 2012). **Armenia:** Syunik Province (former Goris Province) (Ogandzhanyan 1984). **Azerbaijan:** Alazani River (Ter-Vartanov et al. 1956), Lankaran (Filippova 1977), Shaki District (Tsapko and Kotti 2017). **Georgia:** Kutaisi, Lagodekhi, Dedoplistsqaro (Kirschenblatt 1936; Djaparidze 1960), Guria (Sukhiashvili et al. 2020). **Turkmenistam:** outskirts of Magtymguly, Aydere (Berdyev and Annaev 1997).

Ecology and other information. *Ixodes frontalis* is an exophilic tick species parasitizing primarily dendrophilic birds (Filippova 1977). It is relatively widely distributed throughout Europe, Western Asia, as well as North Africa (Filippova 1977; Estrada-Peña et al. 2018). *Ixodes frontalis* is rare in most of its range. However, the place of mass reproduction of this species was discovered in Dagestan near the Sulak River in a big colony of rooks (Gusev and Guseva 1960). Under the nests in the rookery, a high, uncountable number of larvae of these ticks was observed. Often there were up to 5,000 individuals per m^2 (Tsapko 2023).

Single collections of *I. frontalis* from mammals are known as exceptions. In Europe, adults were found on representatives of the mustelid family (Guglielmone et al. 2014). In the Shaki District of Azerbaijan (2 km north of the village of Şirinbulaq, 31 Oct 1956), two nymphs were taken from two Libyan jird *Meriones libycus* (collections of R.B. Kosminsky and R.S. Karandina) (Tsapko and Kotti 2017). In addition, certain cases of attachments to humans are known (Gilot et al. 1997).

Ixodes turdus Nakatsudi, 1942

Ixodes turdus Nakatsudi, 1942: 287.

Recorded hosts. Aves: *Turdus pallidus* Gmelin (pale thrush) (Bolotin and Kolonin 1979).

Figure 37. Map of Russia and neighboring countries showing the locations where *Ixodes turdus* was reported.

Recorded locations (Fig. 37). Russia: Primorsky Krai, Nadezhdinsky District, the right shore of the Razdolnaya River (Bolotin and Kolonin 1979).

Ecology and other information. *Ixodes turdus* is a bird-associated tick species that can be found usually in East Asia, especially in Nepal, Korea, and Japan (Takahashi and Chunikhin 1972; Clifford et al. 1975; Ishiguro et al. 2000; Kim et al. 2009b; Sato et al. 2021). The single case of finding *I. turdus* in the Far East of Russia is considered a result of transportation (Bolotin and Kolonin 1979). Some occasions of parasitism on humans (Woo et al. 1990; Kadosaka and Hasegawa 1996), as well as on wild boars (Chae et al. 2017) are also recorded.

Discussion

The territory of Russia and other post-Soviet countries reviewed here occupies a significant part of the Palearctic and its *Ixodes* tick fauna comprises in total approximately 37 species belonging to ten subgenera (Table 1). Some of these species are endemic. A significant ratio of these *Ixodes* species have a broad distribution area, as exemplified by *I. ricinus*, *I. persulcatus*, *I. trianguliceps*, *I. apronophorus*, *I. crenulatus*, *I. kaiseri*, *I. laguri*, *I. redikorzevi*, *I. eldaricus*, *I. frontalis*, and *I. lividus*. Moreover, the geographical range of some of these species also continues further to the west (into Europe) and to the south and east (to other parts of Asia).

Tick species like *I. ricinus* and *I. persulcatus* are able to live in a broad range of forest and forest-steppe biotopes and parasitize literally any vertebrate hosts among mammals, birds, and in some cases reptiles available in their habitats. Further species listed above parasitize species of those ecological groups of higher vertebrates which are widely distributed within the limits of the reviewed territories and even outside of them (like shrews, rodents, carnivores, and passerines), so this could explain the wide distribution of these species together

with the presence of suitable hosts and biotopes. On the other hand, five tick species – *I. stromi*, *I. semenovi*, *I. signatus*, *I. uriae*, *I. occultus* – have more limited distribution areas, occurring only in certain habitats where they are specialized to parasitize an ecologically restricted range of hosts. There are at least five tick species (*I. angustus*, *I. pomerantzevi*, *I. nipponensis*, *I. kashmiricus*, *I. redikorzevi*) which have geographical ranges extending far beyond post-Soviet territories, and these also occur in neighboring and more distant countries sharing a similar fauna. The distribution areas of six further species (*I. berlesei*, *I. caledonicus*, *I. arboricola*, *I. subterraneus*, *I. simplex*, *I. vespertilionis*) cannot be defined more precisely, due to the limited number of their findings in locations distantly separated from each other. It is important to note here that these ticks are nidicolous parasites of birds and bats, therefore can be transported by their hosts to new habitats in other locations during migration, although it is not necessary that they will establish and form sustainable populations there. The distribution area of the tick *I. pavlovskyi* is also disjunct and populated by two different subspecies. Finally, there are four tick species known exclusively from the reviewed territories and certain locations by a very few records and their real distribution areas and biology are poorly studied, namely *I. cornutus*, *I. ghilarovi*, *I. maslovi*, and *I. prokopjevi*.

It is still questionable whether or not *I. brunneus* and *I. turdus* are indigenous in the examined geographical area. There have been no confirmations of stable populations of these two species in the locations where both species were found on migratory birds; both are known from these territories by single specimens outside their main distribution areas. Therefore, we suspect that these two tick species do not belong to the tick fauna of Russia and post-Soviet territories.

Among the reviewed *Ixodes* species, from the point of view of host preferences, there are both generalists and specialists. Rodents of the families Muridae and Cricetidae, as well as passerine birds, harbor the highest number of *Ixodes* species in the reviewed territories (Table 2). All these groups live almost everywhere in a great variety of biotopes, often in significant numbers, therefore playing an important role in diverse ecosystems and also having epidemiological significance as reservoirs of multiple tick-borne pathogens. Among the ticks in this review, 15 species parasitize murine rodents and 14 passerine birds (Table 2). Shrews (family Soricidae) also include a relatively high number of species which are ubiquitous and serve as typical hosts for certain *Ixodes* species, predominantly from the subgenera *Filippoviella* and *Ixodiopsis*.

In general, 18 *Ixodes* species are typically parasites of mammals from various taxonomic and ecological groups, 12 species prefer birds as hosts. Altogether, six species are generalists and therefore can parasitize virtually any available warm-blooded host species. All these species belong to the subgenus *Ixodes*. Ticks from other subgenera can attach to and feed from atypical hosts occasionally. Specific parasites of reptiles among *Ixodes* species are not known to occur in the reviewed territories, but some of the generalist species can parasitize these hosts, especially in the absence of their preferred ones. Sometimes even mass parasitism of *Ixodes* species can be observed on reptiles, as in the case of *I. redikorzevi*. Last, we can note that hosts of *I. maslovi* are still unknown, and the exact host range of *I. cornutus*, *I. ghilarovi*, *I. prokopjevi*, and *I. sachalinensis* also remains to be clarified.

Table 1. The list of *Ixodes* subgenera and species according to post-Soviet countries.

Tick subgenus	Tick species	Russia	Belarus	Ukraine	Moldova	Georgia	Armenia	Azerbaijan	Kazakhstan	Kyrgyzstan	Uzbekistan	Turkmenistan	Tajikistan
Ceratixodes	*I. uriae*	+											
Eschatocephalus	*I. simplex*	+		+				+					
	I. vespertilionis	+		+	+	+	+	+		+		+	+
Filippoviella	*I. ghilarovi*	+				+							
	I. trianguliceps	+	+	+	+	+	+	+					
Ixodes	*I. apronophorus*	+	+	+	+				+	+			
	I. eldaricus	+		+		+	+	+	+	+	+	+	+
	I. kazakstani								+	+			
	I. kashmiricus									+			
	I. laguri	+		+	+	+	+	+	+			+	
	I. nipponensis	+											
	I. occultus								+		+	+	
	I. pavlovskyi	+							+	+			
	I. persulcatus	+	+	+					+	+			
	I. redikorzevi	+		+	+	+	+	+	+	+	+	+	+
	I. ricinus	+	+	+	+	+	+	+	+			+	
	I. sachalinensis	+											
Ixodiopsis	*I. angustus*	+											
	I. pomerantzevi	+											
	I. stromi	+							+	+			+
Monoixodes	*I. maslovi*	+											
Pholeoixodes	*I. arboricola*	+	+	+	+	+	+	+		+			
	I. cornutus												+
	I. crenulatus	+	+	+	+	+	+		+	+	+	+	+
	I. hexagonus			+									
	I. kaiseri	+		+	+	+	+	+	+	+			
	I. lividus	+	+	+	+				+				
	I. prokopjevi	+											
	I. subterraneus	+							+	+		+	+
Scaphixodes	*I. signatus*	+											
	I. berlesei	+							+	+		+	+
	I. caledonicus	+		+				+					+
	I. unicavatus			+									
	I. semenovi								+	+			
Trichotoixodes	*I. brunneus* *			+									
	I. frontalis	+	+	+	+	+	+	+				+	
	I. turdus *	+											
Total number of species		**29**	**8**	**18**	**11**	**11**	**10**	**11**	**16**	**15**	**4**	**10**	**9**
Total number of subgenera		**9**	**4**	**6**	**5**	**5**	**5**	**6**	**4**	**5**	**2**	**5**	**5**

* non-indigenous (transported) tick species in the reviewed territories.

Table 2. The list of *Ixodes* tick subgenera and species according to host taxa recorded in post-Soviet countries.

Tick subgenus	Tick species	Host taxonomic groups
Ceratixodes	*I. uriae*	**Aves:**
		Charadriiformes – Alcidae, Laridae;
		Suliformes – Phalacrocoracidae;
		Procellariiformes – Procellariidae
Eschatocephalus	*I. simplex*	**Mammalia**:
		Chiroptera
	I. vespertilionis	**Mammalia**:
		Chiroptera
Filippoviella	*I. ghilarovi*	**Mammalia**:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae
	*I. triangulicep*s	**Mammalia**:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae, Sminthidae
Ixodes	*I. apronophorus*	**Mammalia**:
		Eulipotyphla – Erinaceidae, Soricidae, Talpidae;
		Rodentia – Cricetidae, Muridae, Sciuridae, Sminthidae;
		Lagomorpha – Leporidae;
		Carnivora – Canidae, Mustelidae
	I. eldaricus	**Aves:**
		Galliformes;
		Passeriformes;
		Strigiformes
		Mammalia:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae
	I. kazakstani	**Aves:**
		Galliformes
		Mammalia:
		Lagomorpha – Leporidae;
		Rodentia – Cricetidae, Muridae, Gliridae
	I. kashmiricus	**Mammalia**:
		Rodentia – Muridae;
		Carnivora – Canidae;
		Artiodactyla – Bovidae
	I. laguri	**Mammalia:**
		Eulipotyphla – Erinaceidae;
		Rodentia – Cricetidae, Gliridae, Dipodidae, Muridae, Sciuridae, Spalacidae;
		Carnivora – Canidae, Mustelidae
	I. nipponensis	**Mammalia:**
		Rodentia – Cricetidae, Muridae
	I. occultus	**Mammalia**:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae, Sciuridae
	I. pavlovskyi	**Aves:**
		Anseriformes;

Tick subgenus	Tick species	Host taxonomic groups
Ixodes	*I. pavlovskyi*	Columbiformes;
		Galliformes;
		Gruiformes;
		Passeriformes
		Mammalia:
		Eulipotyphla – Soricidae;
		Lagomorpha – Leporidae, Ochotonidae;
		Rodentia – Cricetidae, Muridae, Sciuridae, Sminthidae
	I. persulcatus	Any mammalian and avian hosts (rarely reptilian) available
	I. redikorzevi	**Aves:**
		Anseriformes;
		Columbiformes;
		Galliformes;
		Passeriformes;
		Pterocliformes
		Mammalia:
		Eulipotyphla – Erinaceidae, Soricidae;
		Lagomorpha – Leporidae;
		Rodentia – Cricetidae, Gliridae, Muridae, Sciuridae, Sminthidae, Spalacidae
		Carnivora – Canidae, Mustelidae
		Reptilia:
		Squamata – Lacertidae
	I. ricinus	**Mammalia, Aves, Reptilia**
	I. sachalinensis	**Mammalia**:
		Lagomorpha – Leporidae
Ixodiopsis	*I. angustus*	**Mammalia**:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae, Sciuridae, Sminthidae;
		Lagomorpha – Ochotonidae
	I. pomerantzevi	**Mammalia**:
		Eulipotyphla – Erinaceidae, Soricidae;
		Rodentia – Cricetidae, Muridae, Sciuridae
	I. stromi	**Mammalia**:
		Eulipotyphla – Soricidae;
		Rodentia – Cricetidae, Muridae;
		Lagomorpha – Ochotonidae;
		Carnivora – Mustelidae
Monoixodes	*I. maslovi*	Unknown
Pholeoixodes	*I. arboricola*	**Aves:**
		Accipitriformes;
		Bucerotiformes;
		Columbiformes;
		Passeriformes;
		Piciformes;
		Strigiformes;
		Falconiformes
	I. cornutus	**Mammalia**:
		Carnivora – Mustelidae

Tick subgenus	Tick species	Host taxonomic groups
Pholeoixodes	*I. crenulatus*	**Mammalia**:
		Eulipotyphla – Erinaceidae;
		Rodentia – Cricetidae, Muridae, Sciuridae, Pálcaidé;
		Lagomorpha – Ochotonidae, Leporidae;
		Carnivora – Canidae, Felidae, Mustelidae, Procyonidae
	I. hexagonus	**Mammalia**:
		Eulipotyphla – Erinaceidae;
		Lagomorpha – Leporidae;
		Carnivora – Canidae, Felidae, Mustelidae
	I. kaiseri	**Mammalia**:
		Eulipotyphla – Erinaceidae;
		Rodentia – Hystricidae;
		Lagomorpha – Leporidae;
		Carnivora – Canidae, Felidae, Hyaenidae, Mustelidae
	I. lividus	**Aves:**
		Passeriformes;
		Coraciiformes
	I. prokopjevi	**Mammalia**:
		Eulipotyphla – Erinaceidae
	I. subterraneus	**Aves:**
		Galliformes;
		Passeriformes;
		Strigiformes;
		Falconiformes
Scaphixodes	*I. signatus*	**Aves:**
		Phalacrocoracidae – Phalacrocoracidae
	I. berlesei	**Aves:**
		Apodiformes;
		Passeriformes;
		Falconiformes
	I. caledonicus	**Aves:**
		Apodiformes;
		Columbiformes;
		Passeriformes;
		Falconiformes
	I. unicavatus	**Aves:**
		Suliformes – Phalacrocoracidae
	I. semenovi	**Aves:**
		Passeriformes
Trichotoixodes	*I. brunneus* *	**Aves:**
		Passeriformes
	I. frontalis	**Aves:**
		Caprimulgiformes;
		Columbiformes;
		Galliformes;
		Passeriformes;
		Falconiformes
	I. turdus *	**Aves:**
		Passeriformes

* non-indigenous (transported) tick species in the reviewed territories.

Acknowledgements

The authors would like to thank the indispensable contributions of Ms. Veronika Lili Németh to the final format and the reference list.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

No funding was reported.

Author contributions

Denis Fedorov: writing, data curation, methodology. Sándor Hornok: conceptualization, writing, methodology.

Author ORCIDs

Denis Fedorov https://orcid.org/0000-0003-0991-5728
Sándor Hornok https://orcid.org/0000-0002-1125-5178

Data availability

All of the data that support the findings of this study are available in the main text.

References

Abdikarimov ST, Ibragimov ES, Egembergenov CE (2018) Current epizootic condition of natural plague foci in Kyrgyz republic and measures aimed at provision of epidemiological welfare as regards plague. Problemy Osobo Opasnyh Infekcij 2: 45–48. https://doi.org/10.21055/0370-1069-2018-2-45-48 [In Russian]

Abdulmagomedov SS, Bittirov AM, Kabardiev SS, Gazimagomedov MG, Ustarov RD, Zubairova MM, Bittirov IA, Musaev ZG, Uyanaeva FB, Bittirova AA (2017) Ecological and epizootic analysis of the Ixodida tick fauna being the main vectors of *Babesia bovis* infection of cattle in the Kizilyurt, Kizlyar and Buinaksk districts of Dagestan. Teorija I Praktika Bor'by S Parazitarnymi Boleznjami 18: 7–10. [In Russian]

Adamovich VL (1968) The distribution and phenology of the tick *Ixodes apronophorus* P. Sch. in foci of tularaemia in the Polesie province. Parazitologiia 2(5): 421–423. [In Russian]

Afanas'eva OV (1959) Ixodid ticks of Tarbagatay. Trudy Sredneaziatskogo Nauchno-Issledovatel'skogo Protivochumnogo instituta 1(6): 275–284. [In Russian]

Akimov IA, Nebogatkin IV (2002) Ixodid ticks in Kyiv – urban zoological and epizootological aspects. Vestnik Zoologii 36(1): 91–95. [In Russian]

Akimov IA, Nebogatkin IV (2013) Ixodid ticks (Acari: Ixodidae) on the banks of lakes in the metropolitan area (for example, Kyiv) and determine the feasibility of measures against ticks. Veterinární Medicína 97: 372–374. [In Russian]

Akimov IA, Nebogatkin IV (2016) Ticks in urban landscapes of Kyiv. The II Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, 195 pp. [In Russian]

Akyshova B, Chen YN, Chen J (2022) Abundance of ectoparasitic ticks and mites (Acari: Ixodida, Mesostigmata, Trombidiformes) on rodents in the Alamedin Gorge of Kyrgyz Range, Kyrgyzstan. Systematic and Applied Acarology 27(6): 1120–1131. https://doi.org/10.11158/saa.27.6.11

Aliev SK, Rashkueva ZI, Gadzhieva RW (2007) Parasite fauna of rodents of the North-Eastern Caucasus. Rossijskij Parazitologiceskij Zurnal 1: 5–10. [In Russian]

Aliev SK, Mutalimova RZ, Alieva HS (2012) Ixodofauna of passerine birds of Dagestan. Izvestija Dagestanskogo Gosudarstvennogo Pedagogicheskogo Universiteta. Estestvennye I Tochnye Nauki 4: 14–17. [In Russian]

Allenov AV, Zvereva TV, Nikitin AY, Tatrova EV, Mamedalieva IV, Solodkaya NS (2015) Comparative analysis of the number and frequency of contacts of ixodid ticks with humans in the south of Primorsky Krai. Tihookeanskij Medicinskij Zhurnal 3(61): 58–60. [In Russian]

Amirova NA, Pakizh VI, Chepeliuk MA, Suprun VG, Sergeeva NI (1989) Ixodid ticks of Pavlodar Province and their participation in the circulation of tularemia infection. Parazitologiia 23(3): 267–274. [In Russian]

Anastos G (1957) The ticks or Ixodides of the U.S.S.R.: a review of the literature. Department of Health, Education and Welfare. Public Health Service. Publication No. 548, Washington, D.C., 397 pp.

Andryushchenko YuA, Bagrikova NA, Dovgal IV, Evstafiev IL, Karpenko SA, Kotenko AG, Kotenko TI, Kostin SYu, Kostyushin VA, Kinda VV, Maslov II, Nesterov YuV, Popenko VM, Sarkina IS, Tovpinets NN, Khodosovtsev AE (2005) The nature of Sivash region and human impact on it (Research history and bibliography). Wetlands International Black Sea Programme, Kyiv, 232 pp. [In Russian]

Apanaskevich DA, Greiman SE, Fedorov DS, Ahmed R, Barker SC (2024) A new subgenus of hard ticks, *Filippoviella* n. subgen. (Acari: Ixodidae) comprising *Ixodes triangluliceps* Birula, 1895 and *I. ghilarovi* Filippova & Panova, 1988, parasites of small mammals in Europe and Asia. Zootaxa 5443(2): 224–236. https://doi.org/10.11646/zootaxa.5443.2.5

Arthur DR (1956) The ixodid ticks of Chiroptera (Ixodoidea, Ixodidae). The Journal of Parasitology 46(2): 180–196. https://doi.org/10.2307/3274734

Arthur DR (1957) Two North African *Ixodes* ticks: *I. kaiseri* sp. n. from Egyptian desert fox cubs. A redescription of the female and a description of the male of *I. festai* Rondelli, 1926 (Ixodoidea, Ixodidae). The Journal of Parasitology 43(5): 578–585. https://doi.org/10.2307/3274481

Arthur DR (1960) The male and nymph of *Ixodes kaiseri* Arthur, 1957. Bulletin of the Research Council of Israel 9B(1): 35–40.

Arthur DR (1963) British ticks. Butterworths, London, 213 pp.

Arthur DR (1965) Ticks of the genus Ixodes in Africa. The Athlone Press, University of London, London, 348 pp.

Arumova EA, Dineva AI (1973) Find of *Ixodes stromi*, Fil, 1957 in the Western Sayan. Medicinskaja Parazitologiya I Parazitarnye Bolezni 42(3): 353–354. [In Russian]

Arzamasov IT (1963) Ectoparasites of rodents. In: Fauna and ecology of rodent parasites. Nauka I Tehnika, Minsk, 138–235. [In Russian]

Asanuma K (1951) Notes on the tick, *Ixodes angustus* Neum., new to Asia. Misc. Rep. Res. Inst. Nat. Resour. Tokyo 22: 1–4.

Baggs EM, Stack SH, Finney-Crawley JR, Simon NPP (2011) *Peromyscus maniculatus*, a possible reservoir host of *Borrelia garinii* from the Gannet Islands off Newfounland and Labrador. The Journal of Parasitology 97(5): 792–794. https://doi.org/10.1645/GE-2548.1

Baisarova ZT (2021) Biology and morphology of ixodid ticks in the territory of the Chechen Republic. Mezhdunarodnyj Nauchno-Issledovatel'skij Zhurnal 6108: 152–156. [In Russian] https://doi.org/10.23670/IRJ.2021.108.6.036

Balashov YS (1998) Ticks – parasites and vectors of infections. Nauka, St. Petersburg, 287 pp. [In Russian]

Balashov YS, Grigorieva LA, Oliver J (1998) Reproductive isolation and interspecific hybridization of ixodid ticks of the *Ixodes ricinus* – *I. persulcatus* group (Acarina, Ixodidae). Entomologicheskoe Obozrenie 77(3): 713–721. [In Russian]

Barker SC, Murrell A (2004) Systematics and evolution of ticks with a list of valid genus and species names. Parasitology 129(1): 15–36. https://doi.org/10.1017/S0031182004005207

Beaucournu JC (1966) On some palearctic Ixodoidea (Acarina) infesting micro-Chiroptera. Annales de Parasitologie Humaine et Comparee 41: 495–502. https://doi.org/10.1051/parasite/1966415495

Beaucournu JC (1967) Contribution a la connaissance de la biologie d'*Ixodes* (*Eschatocephalus*) *vespertilionis* Koch, 1844 et d'*Ixodes* (*Pomerantzevella*) *simplex* Neumann, 1906 (Acarina, Ixodoidea) parasites des Chiroptères. Ann Speleologie 22: 543–580.

Bekleshova AY, Terskikh II, Smirnov VA (1970) Arboviruses isolated from bird ticks *Ceratixodes putus* Pick.-Cambr. collected in the Arctic regions. Voprosy Virusologii 15(4): 436–440. [In Russian]

Belopolskaya MM (1952) The parasite fauna of marine birds. Uchjonye Zapiski LGU. Serija Biologicheskih Nauk 141(28): 127–180. [In Russian]

Belova YN, Shabunov AA, Filonenko IV (2008) Fauna diversity in terrestrial ecosystems. In: Bolotova NL, Maksutova NK, Shabunov AA (Eds) Preservation of the biodiversity of natural complexes of the catchment area of Lake Onega in the territory of the Vologda Oblast. Vol. 1. Vologda State Pedagogical Institute, Vologda, 90–113. [In Russian]

Belova OA, Polienko AE, Averianova AD, Karganova GG (2023) Hybrids of *Ixodes ricinus* and *Ixodes persulcatus* ticks effectively acquire and transmit tick-borne encephalitis virus. Frontiers in Cellular and Infection Microbiology 13(4): 1104484. https://doi.org/10.3389/fcimb.2023.1104484

Belozerov VN (1976) Life cycles and seasonal adaptations in ixodid ticks (Acarina, Ixodoidea). Chtenija Pamjati O. N. Holodkovskogo. Leningrad, Nauka: 53–101. [In Russian]

Belyaev VG (1963) On the fauna of ectoparasites of Magadan Province. Doklady Irkutskogo Protivochumnogo Instituta 5: 180–185. [In Russian]

Belyaev VG, Filippova NA (1976) On the two close species of the subgenus *Ixodiopsis* from Southern Primorye. In: Tezisy Dokladov Tret'ego Akarologicheskogo Soveshhanija, Tashkent, 1976: 43. [In Russian]

Berdyev AB (1973) The occurrence of the tick *Ixodes eldaricus* Djap., 1950 on rodents in the Kopet Dagh (Ixodoidea, Ixodidae). Parazitologiia 7(2): 183–185. [In Russian]

Berdyev AB, Annaev Ya (1997) Fauna of ixodid ticks from the Kopet-Dagh in relation to the compilation of their checklist. Parazitologiia 31(2): 104–115. [In Russian]

Bespyatova LA, Bugmyrin SV (2015) Ixodid ticks (Parasitiformes: Ixodidae) from small mammals in deforested boreal habitats in Northern European Russia. Parazitologiia 49(5): 376–390. [In Russian]

Bespyatova LA, Bugmyrin SV (2021) On the distribution of the castor bean tick *Ixodes ricinus* (Acarina, Ixodidae) in the Republic of Karelia, Russia. Entomological Review 101(4): 581–591. https://doi.org/10.1134/S0013873821040084

Bespyatova LA, Bugmyrin SV, Kutenkov SA, Nikonorova IA (2019) The abundance of ixodid ticks (Acari: Ixodidae) on small mammals in forest biotopes of the middle

taiga subzone of Karelia. Parazitologiya 53(6): 463–473. https://doi.org/10.1134/S0031184719060036 [In Russian]

Bibikov DI, Bibikova VA (2010) On the study of the dancing wheatear *Oenanthe isabellina* and its ectoparasites. Rossijskij Ornitologicheskij Zhurnal 19(562): 618–629. [In Russian]

Bibikov DI, Golubeva KN, Chekalin VB, Tarakanov NF (1961) Materials to the epizootological characterization of the Dzungarian Alatau. Communication 1. Trudy Sredneaziatskogo Nauchno-Issledovatel'skogo Protivochumnogo instituta 7: 115–120. [In Russian]

Birula A (1895) Ixodidae novi vel parum cogniti Musei Zoologici Academiae Caesareae Scientiarum Petropolitanae. I. Bulletin de l'Académie Impériale des Sciences de St.-Pétersbourg, Series 5, 2(4): 353–364.

Bittirova AA, Musaev ZG, Bittirov IA, Begieva SA, Bittirov AM (2019) Fauna of ixodid ticks of the genera *Dermacentor*, *Ixodes*, *Hyalomma* in the foothills and mountain pastures of the Main Caucasus Mountain Range. Teorija I Praktika Bor'by S Parazitarnymi Boleznjami 20: 136–140. https://doi.org/10.31016/978-5-9902340-8-6.2019.20.136-140 [In Russian]

Bobkova OA (2003) Distribution of ticks (Ixodoidea, Parasitiformes) – ectoparasites of bats (Chiroptera) in Ukraine. Vestnik Zoologii 37(6): 23–28. [In Russian]

Bobrovskikh TK (1979) Ecology and distribution of the tick *Ixodes lividus* in Karelia (Ixodidae). Parazitologiia 13(5): 545–546. [In Russian]

Bogdanov II, Yakimenko VV (2016) Ectoparasites and nidicoles of the root vole (*Microtus oeconomus* Pall.) among ticks (Acari, parasitiformes) and fleas (Insecta, Siphonaptera) in Western Siberia and Altai. Nacional'nye Prioritety Rossii 4(22): 14–17. [In Russian]

Bolotin EI (2000) Zoogeographic analysis of the fauna of ixodid ticks (Parasitiformis, Ixodidae) of Primorye. Chtenija Pamjati A. I. Kurencova 9: 65–90. [In Russian]

Bolotin EI, Kolonin GV (1979) New data on the fauna of ixodid ticks of the Primorsky Krai. Zoologicheskij Zhurnal 58(3): 435–436. [In Russian]

Bolotin EI, Kolonin GV, Kiselev AN, Matiushina OA (1977) Distribution and ecology of *Ixodes pavlovskyi* (Ixodidae) in Sykhote-Alin. Parazitologiia 11(3): 225–229. [In Russian]

Bolshakova NP, Kuranova VN, Kravchenko LB, Gashkov SI, Korobitsyn IG, Yartsev VV, Zhigalin AV, Bastrikova AE, Moskvitina NS (2019) Field and experimental studies of terrestrial vertebrates: a teaching aid for biological specialties of universities. Izdatel'skij Dom Tomskogo Gosudarstvennogo Universiteta, Tomsk, 88 pp. [In Russian]

Bragina EA, Kolchanova LP, Stepanova TF (2013) Infecction of *Ixodes* ticks with monocytic ehrlichiosis and human granulocytic anaplasmosis in the territory of the Tyumen region. Zdorov'e Naselenija I Sreda Obitanija 2(239): 33–34. [In Russian]

Bugmyrin SV, Bespyatova LA, Korotkov YS, Burenkova LA, Belova OA, Romanova LI, Kozlovskaya LI, Karganova GG, Ieshko EP (2013) Distribution of *Ixodes ricinus* and *I. persulcatus* ticks in southern Karelia (Russia). Ticks and Tick-Borne Diseases 4(1–2): 57–62. https://doi.org/10.1016/j.ttbdis.2012.07.004

Bugmyrin SV, Belova OA, Ieshko EP, Bespyatova LA, Karganova GG (2015) Morphological differentiation of *Ixodes persulcatus* and *I. ricinus* hybrid larvae in experiment and under natural conditions. Ticks and Tick-Borne Diseases 6(2): 129–133. https://doi.org/10.1016/j.ttbdis.2014.11.001

Bugmyrin SV, Belova OA, Bespyatova LA, Ieshko EP, Karganova GG (2016) Morphological features of *Ixodes persulcatus* and *I. ricinus* hybrids: Nymphs and adults. Experimental & Applied Acarology 69(3): 359–369. https://doi.org/10.1007/s10493-016-0036-3

Bursali A, Keskin A, Tekin S (2012) A review of the ticks (Acari: Ixodida) of Turkey: species diversity, hosts and geographical distribution. Experimental & Applied Acarology 57(1): 91–104. https://doi.org/10.1007/s10493-012-9530-4

Bychkova EI, Yakovich MM, Fedorova IA (2015) Environmental aspects of research of ixodid ticks (Ixodidae) in Belarus. In: Conceptual and applied aspects of research and education in invertebrate zoology. Digest of materials of the IV International Conference. Izdatel'skij Dom Tomskogo Gosudarstvennogo Universiteta, Tomsk, 164–167. [In Russian]

Camicas J-L, Hervy J-P, Adam F, Morel P-C (1998) Les tiques du monde (Acarida, Ixodida). Nomenclature, stades décrits, hôtes, répartition. ORSTOM, Paris, 233 pp.

CBD [Convention on Biological Diversity] (2023) Russian Federation - Biodiversity Facts – Status and trends of biodiversity, including benefits from biodiversity and ecosystem services. https://www.cbd.int/countries/profile/?country=ru [Accessed August 30, 2023]

Chae JB, Kang JG, Kim HC, Chong ST, Lee IY, Shin NS, Chae JS (2017) Identification of tick species collected from wild boars and habitats of wild boars and domestic pigs in the Republic of Korea. Korean Journal of Parasitology 55(2): 185–191. https://doi.org/10.3347/kjp.2017.55.2.185

Chen Z, Yang X, Bu F, Yang X, Yang X, Liu J (2010) Ticks (Acari: Ixodoidea: Argasidae, Ixodidae) of China. Experimental & Applied Acarology 51(4): 393–404. https://doi.org/10.1007/s10493-010-9335-2

Chernousova NF, Tolkachyov OV (2009) Ectocenoses of small mammals in urbanized areas of the forest zone. Vestnik Krasnojarskogo Gosudarstvennogo Agrarnogo Universiteta 8: 55–62. [In Russian]

Cho BK, Nam HW, Cho SY, Lee WK (1995) A case of tick bite by a spontaneously retreated *Ixodes nipponensis*. Korean Journal of Parasitology 33(3): 239–242. https://doi.org/10.3347/kjp.1995.33.3.239

Chu JP, Cho YJ, Jeong GS, Ko BM (1997) A case of tick infestation in chest wall by *Ixodes nipponensis*. Korean Journal of Infectious Diseases 29(1): 53–56.

Chunihin SP (1967) *Ixodes berlesei* Bir. – new tick species in Western Siberia. Zoologicheskij Zhurnal 46(8): 1256–1258. [In Russian]

Clifford CM, Sonenshine DE, Keirans JE, Kohls GM (1973) Systematics of the subfamily Ixodinae (Acarina: Ixodidae). 1. The subgenera of *Ixodes*. Annals of the Entomological Society of America 66(3): 489–500. https://doi.org/10.1093/aesa/66.3.489

Clifford CM, Hoogstraal H, Keirans JE (1975) The *Ixodes* ticks (Acarina: Ixodidae) of Nepal. Journal of Medical Entomology 12(1): 115–137. https://doi.org/10.1093/jmedent/12.1.115

Cooley RA (1946) Note on the tick, *Ixodes angustus* Neumann. The Journal of Parasitology 32(2): 210–210. https://doi.org/10.2307/3272601

Cooley RA, Kohls GM (1945) The genus *Ixodes* in North America. National Institute of Health Bulletin 184: 246.

Danchinova GA, Khasnatinov MA, Zlobin VI, Kozlova IV, Verkhozina MM, Suntsova OV, Shulunov SS, Abmed D, Bataa J, Bat-Ochir D, Tsend N, Badueva LN, Lisak OV, Gorina MO (2006) Ixodid ticks in southern part of Eastern Siberia and Mongolia and their spontaneous infectiveness by infectious agents. Biulleten' Sibirskoi Meditsiny 5(1): 137–143. https://doi.org/10.20538/1682-0363-2006--137-143 [In Russian]

Danchinova GA, Khasnatinov IA, Shulunov SS, Arbatskaya AV, Badueva LB, Suntsova IV, Tchaporgina AA, Bogomazova IL, Timoshenko AF (2007) Fauna and ecology of ixodid ticks in Pribaikalye. Acta Biomedica Scientia 3(55): 86–89. [In Russian]

Davydova MS, Lukin AM (1969) Landscape and geographical distribution of ixodid ticks. Biologicheskoe Rajonirovanie Novosibirskoj Oblasti, Novosibirsk, 250–264. [In Russian]

Denisov AA (2010) Features of distribution of fauna of ticks in the territory of the Lower Volga region. Izvestija Orenburgskogo Gosudarstvennogo Agrarnogo Universiteta 3(27): 210–213. [In Russian]

Denisov AA (2019) Faunistic and ecological features of blood-sucking arthropods of the family Ixodidae in biocenosis of the Lower Volga zone. Prirodnye Sistemy I Resursy 9(1): 21–26. https://doi.org/10.15688/nsr.jvolsu.2019.1.3 [In Russian]

Didyk YuM (2013) Mites of the bird nests from the Danube Biosphere Reserve and the Black Sea Biosphere Reserve of Ukraine. Naukovi zapiski Derzhavnogo prirodoznavchogo muzeju 29: 13–18. [In Ukrainian]

Dietrich M, Kempf F, Gómez-Díaz E, Kitaysky AS, Hipfner JM, Boulinier T, McCoy KD (2012) Inter-oceanic variation in patterns of host associated divergence in a seabird ectoparasite. Journal of Biogeography 39(3): 545–555. https://doi.org/10.1111/j.1365-2699.2011.02620.x

Dilbaryan KP, Poghosyan TE (2018) Landscape adaptation of the Ixodidae of the southern slope of Aragats mountain range. Electronic Journal of Natural Sciences 30(2): 47–49.

Djaparidze NI (1950) New species of ticks of the fam. Ixodidae from Georgia. Soobscheniya AN GSSR 2: 117–121. [In Russian]

Djaparidze NI (1960) Ixodid ticks of Georgia. Izdatel'stvo Akademii Nauk Gruzinskoi SSR, Tbilisi, 295 pp. [In Russian]

Doss MA, Anastos G (1977) Index-catalogue of medical and veterinary zoology. Special publication N°. 3. Ticks and tick-borne diseases. III. Checklist of families, genera, species and subspecies of ticks. United States Government Printing Office, Washington, D.C., 97 pp.

Dubinin VB, Bregetova NG (1952) Parasitic blood-sucking acari of vertebrate animals of Turkmenistan. Trudy ZIN AN SSSR 10: 45–60. [In Russian]

Durden LA, Gerlach RF, Beckmen KB, Greiman SE (2018) Hyperparasitism and non-nidicolous mating by male *Ixodes angustus* ticks (Acari: Ixodidae). Journal of Medical Entomology 55(3): 766–768. https://doi.org/10.1093/jme/tjy012

Duron O, Jourdain E, McCoy KD (2014) Diversity and global distribution of the *Coxiella* intracellular bacterium in seabird ticks. Ticks and Tick-Borne Diseases 5(5): 557–563. https://doi.org/10.1016/j.ttbdis.2014.04.003

Egorov DS, Kruchkova EN, Egorov SV (2016) Peculiarities of distribution of larvae and nymphs of *Ixodes* ticks according to the host species in the natural foci of *Babesia canis* infections in the Eastern Upper Volga. Teorija I Praktika Bor'by S Parazitarnymi Boleznjami 17: 166–167. [In Russian]

Eley Jr TJ (1977) *Ixodes uriae* (Acari: Ixodidae) from a river otter. Journal of Medical Entomology 13(4–5): 506. https://doi.org/10.1093/jmedent/13.4-5.506

Emchuk EM (1955) New species of ticks – *Ixodes pospelovae* (sp. n.). DAN USSR 6: 606–607. [In Russian]

Emchuk EM (1960) Fauna of Ukraine. Ixodid ticks. Izdatel'stvo AN USSR, Kyiv, 163 pp. [In Russian]

Emchuk EM (1967) Certain biological peculiarities of *Ixodes redikorzevi* Olen. In: Problemy parazitologii. Ukrainskoye Respublicanskoye Obschestvo Parasitologov. Kiev, 354–355. [In Russian]

Emchuk EM (1972) Role of birds in formation of the regional fauna of ixodid ticks and the transfer of pathogens of infectious diseases. Problemy parasitologii 290–292. [In Russian]

Emelyanova ND (1972) Ectoparasites of birds of Eastern Siberia and the Far East. In: Transkontinental'nye svjazi pereletnyh ptic i ih rol' v rasprostranenii arbovirusov. Nauka, Novosibirsk, 397–399. [In Russian]

Emelyanova ND (1979) Taxonomic status of ixodid ticks of the genus *Pholeoixodes* within the subfamily Ixodinae and its division into subgenera. In: Efimov MV, Pronin

NM (Eds) Zooparasitologiya bassejna ozera Bajkal. Akad. nauk SSSR, Sib. Otd. Buret. Filial, Otd. Biol., Ulan-Ude, 5–27. [In Russian]

Emelyanova ND, Gordeeva VP (1969) Materials for the study of birds of the spurs of the East Manchurian Mountain country and the Khanka Plain as hosts of ixodid ticks. In: Cherepanov AI (Ed.) Pereletnye pticy i ih rol' v rasprostranenii arbovirusov. Nauka, Novosibirsk, 160–169. [In Russian]

Emelyanova ND, Koshkin SM (1962) Description of larvae and nymphs of *Ixodes angustus* Neum., 1899 and some data on its biology. Izvestiya Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta Sibiri I Dal'nego Vostoka 24: 344–348. [In Russian]

Emelyanova ND, Kozlovskaya OL (1967) A new species and subgenus of the genus *Ixodes* Latr. (Parasitiformes, Ixodidae) from the Far East of the USSR. Parazitologiia 1(6): 489–494. [In Russian]

Emelyanova ND, Prokopjev VN, Gordeeva VN, Lazorenko LP, Bublienko AV, Kozlovskaya OL (1963) Materials for the study of ticks of the genus *Ixodes* (fam. Ixodidae) of North-Eastern Asia. Doklady Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta 5: 188–193. [In Russian]

Estrada-Peña A (1989) Las garrapatas (Acari: Ixodoidea) parásitas de murciélagos (Mammalia, Chiroptera). (II). Revista Iberica de Parasitologia 49: 165–175. [In Spanish]

Estrada-Peña A, Mihalca AD, Petney TN (2018) Ticks of Europe and North Africa: a guide to species identification. Springer International Publishing, 404 pp. https://doi.org/10.1007/978-3-319-63760-0

Evstafiev IL (2017) Results of a 30-years-long investigation of small mammals in Crimea. Part 3. Parasites and epizootiology. Praci Teriologichnoï Shkoli 15: 111–135. https://doi.org/10.15407/ptt2017.15.111 [In Russian]

Fedorov VG (2016) Some information about ticks of the Ixodoidea superamily sporadically met within the territory of Western Siberia. Al'manah Sovremennoj Nauki I Obrazovanija 7(109): 114–117. [In Russian]

Fedorov DS, Leonovich SA (2021) Analysis of findings and host-parasite relations of the tick *Ixodes trianguliceps* Birula, 1895 (Ixodidae, Ixodinae) in Northwestern Russia and in neighboring European countries. Entomological Review 101(5): 725–732. https://doi.org/10.1134/S0013873821050122

Fedorova SJ (2012a) Ticks (Parasitiformes: Ixodidae) of Kyrgyzstan: biodiversity and epidemiologic role. Izvestiya Vuzov 6: 127–133. [In Russian]

Fedorova SJ (2012b) Ixodid ticks (Ixodidae) of mammals of the Northern Tien Shan. Materials of the International Conference «WILDLIFE OF KAZAKHSTAN AND ADJACENT AREAS» devoted to the 80th anniversary of the Institute of Zoology, 175. [In Russian]

Fedorova SJ (2017) Ixodidae ticks of northern Tien-Shan as environmental indicators. Nauka, Novye Tehnologii I Innovacii V Kyrgyzstane 7: 151–154. [In Russian]

Fedorova SJ (2021) Faunal complex of hard ticks of mammals of the Chuy Valley at different stages of parasitological research. Issledovanie Zhivoj Prirody Kyrgyzstana 2: 117–121. [In Russian]

Filippova NA (1957a) Systematic groups of Palearctic ticks of the subfamily Ixodinae. Bulleten' MOIP. Otdelenie Biologii 62: 31–34. [In Russian]

Filippova NA (1957b) A new tick species, *Ixodes stromi*, and its taxonomic position. Zoologicheskij Zhurnal 36(6): 864–869. [In Russian]

Filippova NA (1958a) Materials concerning the larvae and nymphs of the subfamily Ixodinae Banks, 1907. Parazitologicheskij Sbornik AN SSSR 18: 10–77. [In Russian]

Filippova NA (1958b) On the tick fauna (Parasitiformes, Ixodidae) infesting terrestrial vertebrates in the vicinity of the Lake Issyk-Kul. Parazitologicheskij Sbornik AN SSSR 18: 110–119. [In Russian]

Filippova NA (1961) Contribution to the taxonomy of ticks of the *crenulatus* group (Ixodidae, *Ixodes*, *Pholeoixodes*). Parazitologicheskij Sbornik AN SSSR 20: 226–247. [In Russian]

Filippova NA (1967) Species of the subgenus *Ixodiopsis* (Ixodoidea, Ixodidae, Ixodes) of the fauna of the Soviet Union. Parazitologicheskij Sbornik AN SSSR 23: 100–123. [In Russian]

Filippova NA (1969) Taxonomic aspects of the study of ticks belonging to the genus *Ixodes* Latr. (Ixodoidea, Ixodidae), vectors of tick-borne encephalitis viruses. Entomologicheskoe Obozrenie 48(3): 675–688. [In Russian]

Filippova NA (1971) A new species of ixodid tick (Ixodoieea, Ixodidae), from the Sakhalin Island. Entomologicheskoe Obozrenie 50(1): 236–239. [In Russian]

Filippova NA (1972) New data on ticks of the genus *Ixodes* Latr. (Ixodoidea, Ixodidae) which are specific bat parasites. Entomologicheskoe Obozrenie 51(2): 463–475. [In Russian]

Filippova NA (1974) *Ixodes eldaricus* and its distribution in the south of the USSR. Parazitologiia 8(6): 504–513. [In Russian]

Filippova NA (1977) Ixodid ticks subfamily Ixodinae. Arachnida. Vol. 4. Fauna of the USSR. Nauka, Leningrad, 396 pp. [In Russian]

Filippova NA [Ed.] (1985) Taiga tick *Ixodes persulcatus* Schulze (Acarina, Ixodidae): morphology, taxonomy, ecology, medical significance. Nauka, Leningrad, 416 pp. [In Russian]

Filippova NA (1997) Fauna of Russia. Arachnida, Vol. 4, Part 5: Subfamily Amblyomminae. Nauka, St. Petersburg, 436 pp. [In Russian]

Filippova NA (1999) Sympatry of closely related species of ixodid ticks and its possible role in parasitic systems of natural foci of transmissive diseases. Parazitologiia 33(3): 223–241. [In Russian]

Filippova NA (2002) Morphological barrier in mechanisms of reproductive isolation acting in areas of sympatry of closely related species *Ixodes persulcatus-I. pavlovskyi* and *I. persulcatus-I. ricinus* (Ixodidae). Parazitologiia 36(6): 457–468. [In Russian]

Filippova NA (2007) The phenomenon of morphological inversions in the ontogeny of some Palearctic species of ixodid ticks (Acari: Ixodidae). International Journal of Acarology 33(1): 61–72. https://doi.org/10.1080/01647950708684502

Filippova NA (2008) Type specimens of argasid and ixodid ticks (Ixodoidea: Argasidae, Ixodidae) in the collection of the Zoological Institute, Russian Academy of Sciences (St. Petersburg). Entomological Review 88(8): 1002–1011. https://doi.org/10.1134/S0013873808080149

Filippova NA (2010) Uncommon zoogeographical connections in the subgenus *Exopalpiger* Schultze of the genus *Ixodes* Latreille (Acari, Ixodidae). Entomological Review 90(6): 793–797. https://doi.org/10.1134/S0013873810060151

Filippova NA (2011) Characteristic features of biodiversity in European ixodid ticks (Acari, Ixodidae) as vectors of diseses with natural foci. Parazitologiia 45(3): 161–181. [In Russian]

Filippova NA (2017) The history of the range of ixodid ticks (Acarina, Ixodidae) – carriers of pathogens of natural focal diseases as one of the factors in the formation of their intraspecific biodiversity. Entomologicheskoe Obozrenie 96(1): 157–184. https://doi.org/10.1134/S0013873817020117 [In Russian]

Filippova NA, Belyaev VG (1970) On species of the group *Ixodes persulcatus* (Parasitiformes, Ixodidae). V. *I pavlovskyi* Pom. and *I. nipponensis* Kitaoka et Saito in Primorye. Parazitologiia 4(6): 515–523. [In Russian]

Filippova NA, Panova IV (1975) *Ixodes caledonicus* Nuttall, 1910 (Ixodoidea, Ixodidae) a little-known parasite of wild birds from the fauna of the USSR. Parazitologiia 9(4): 339–347. [In Russian]

Filippova NA, Panova IV (1988) *Ixodes ghilarovi* sp. n., a new relic species of ixodid ticks (Ixodoidea, Ixodidae). Trudy Vsesojuznogo Entomologicheskogo Obschestva 70: 212–217. [In Russian]

Filippova NA, Panova IV (1989) A description of the female and larva of the relic species *Ixodes ghilarovi* (Ixodidae). Parazitologiia 23(5): 419–422. [In Russian]

Filippova NA, Panova IV (1998) Geographical variation of all active stages of ontogenesis as a basis for estimate of intraspecific taxonomic structure of *Ixodes pavlovskyi* (Ixodidae). Parazitologiia 32(5): 396–411. [In Russian]

Filippova NA, Panova IV (2000) Intraspecific variation of nest ambushing tick *Ixodes crenulatus* (Ixodidae). Parazitologiia 34: 265–279. [In Russian]

Filippova NA, Stekol'nikov AA (2007) Assessment of the preimaginal stages of the ticks collected from small mammals in Western and Northern Caucasus (Acari: Ixodidae). Parazitologiia 41(1): 3–22. [In Russian]

Filippova NA, Uspenskaya IG (1973) On the species status of *Ixodes kaiseri* Arthur, 1957 (Ixodidae). Parazitologiia 7(1): 3–13. [In Russian]

Filippova NA, Kochkareva AV, Belskaya GS (1966) Materials about some Ixodoidea tick species of Turkmenistan. Izvestija AN TSSR. Serija biologicheskih nauk 3: 83–86. [In Russian]

Flint VB, Kostryko IN (1967) On biology of the tick *Ixodes putus* Pick-Camb. Zoologicheskij Zhurnal 46(8): 1253–1256. [In Russian]

Frauenfeld GR (1853) Ueber Eschatoccphalns gracilipes, neue Gattung der Zecken. Verhandlungen des Zoologisch-Botanischen Vereins in Wien 3: 55–58.

Galuzo IG (1950) Blood-sucking acari of Kazakhstan. Vol. 4. Izdatel'stvo AN KazSSR, Alma-Ata, 388 pp. [In Russian]

Gaponov SP, Tewelde RT (2021) Epidemiological survey of birds and their mites in Voronezh. Izvestija Vysshih Uchebnyh Zavedenij. Povolzhskij Region. Estestvennye Nauki 1: 40–56. https://doi.org/10.21685/2307-9150-2021-1-5 [In Russian]

Gembetsky AS (1966) About finding the tick *Ixodes arboricola* P. Sch. et Schl. in bird nests. Zoologicheskij Zhurnal 45(12): 1881–1882. [In Russian]

Gembetsky AS (1972) Nidicolous parasites of the birds of the Belarusian Polesie. In: Arzamasov IT (Ed.) Parasites of animals and plants of the Belarusian Polesie: a collection of articles. Nauka I Tehnologii, Minsk, 150–193. [In Russian]

Gern L, Humair PF, Gray J, Kahl O, Lane RS, Stanek G (2002) Ecology of *Borrelia burgdorferi* sensu lato in Europe. In: Gray J, Kahl O, Lane RS, Stanek G (Eds) Lyme Borreliosis, Biology, Epidemiology and Control 6, 149–174. https://doi.org/10.1079/9780851996325.0149

Gilot B, Beaucournu JC (1973) Premier inventaire des tiques d'oiseaux (Acarina, Ixodoidea) de l'Ouest de la France. Présence d'*Ixodes unicavatus* Neumann 1908 en Bretagne. Bulletin de la Société Scientifique de Bretagne 28: 131–141. [In French]

Gilot B, Beaucournu JC, Chastel C (1997) Fixing on man of *Ixodes* (*Trichotoixodes*) *frontalis* (Panzer, 1795) collected with the flagging method. Parasite-Journal De La Societe Francaise De Parasitologie 4(2): 197–199. https://doi.org/10.1051/parasite/1997042197

Glashchinskaya-Babenko LV (1956) *Ixodes lividus* Koch as a representative of nidicolous ticks. In: Ectoparasites, 3. Izdatel'stvo Moskovskogo Universiteta, Moskva, 21–105. [In Russian]

Glazunov YuV, Zotova OV (2014) Distribution and harmfulness of ixodid ticks in the Russian Federation. APK: Innovacionnye Tehnologii 1(24): 51–53. [In Russian]

Glushakova LI, Korabelnikov IV, Egorova YuI (2011) Distribution of *Ixodes persulcatus* in the southern and central regions of the Komi Republic. Medicinskaja Parazitologiya I Parazitarnye Bolezni 3: 48–50. [In Russian]

Golov DA (1933) About species composition and biology of ticks near Almaty in relation to epidemiology of tularemia. Medicinskij Zhurnal Kazahstana 2(3): 32–38. [In Russian]

Gray JS (1998) The ecology of Lyme borreliosis vectors. Experimental & Applied Acarology 22(5): 249–258. https://doi.org/10.1023/A:1006070416135

Gray JS, Dautel H, Estrada-Peña A, Kahl O, Lindgren E (2009) Effects of climate change on ticks and tick-borne diseases in Europe. Interdisciplinary Perspectives on Infectious Diseases 6: 593232. https://doi.org/10.1155/2009/593232

Grebenyuk RV (1961) Ixodid ticks of Kyrgyzstan, their stationary and vertical location. In: Natural Foci of Diseases and Issues of Parasitology. Izdatel'stvo AN KazSSR, Alma-Ata, 477–483. [In Russian]

Grebenyuk RV (1966) Ixodid ticks of Kyrgyzstan. Frunze, Ilim, 328 pp. [In Russian]

Grigoryeva LA, Tretyakov KA (1998) Peculiarity of parasitic system ixodid ticks–*Borrelia*–micromammalia in the North-West of Russia. Parazitologiia 32(5): 422–430. [In Russian]

Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Peña A, Horak IG (2009) Comments on controversial tick (Acari: Ixodida) species names and species described or resurrected from 2003 to 2008. Experimental and Applied Acarology 48: 311–327. https://doi.org/10.1007/s10493-009-9246-2

Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada Peña A, Horak IG, Shao R, Barker SC (2010) The Argasidae, Ixodidae and Nuttalliellidae (Acari: Ixodida) of the world: a list of valid species names. Zootaxa 2528(1): 1–28. https://doi.org/10.11646/zootaxa.2528.1.1

Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Peña A, Horak IG (2014) The hard ticks of the world. Springer, Dordrecht, 738 pp. https://doi.org/10.1007/978-94-007-7497-1

Guglielmone AA, Petney TN, Robbins RG (2020) Ixodidae (Acari: Ixodoidea): descriptions and redescriptions of all known species from 1758 to December 31, 2019. Zootaxa 4871(1): 1–322. https://doi.org/10.11646/zootaxa.4871.1.1

Guglielmone AA, Nava S, Robbins RG (2023) Geographic distribution of the hard ticks (Acari: Ixodida: Ixodidae) of the world by countries and territories. Zootaxa 5251(1): 1–274. https://doi.org/10.11646/zootaxa.5251.1.1

Guiguen C, Monnat JY, Launay H, Beaucournu JC (1987) Ectoparasites des oiseaux en Bretagne: 3. Ixodoidea. Cahiers - ORSTOM. Entomologie Médicale et Parasitologie 25: 73–81.

Guo Y, Sun Y, Xu R (2016) The genus *Ixodes* (Acari: Ixodidae) in China with three new record species. Acta Parasitologica 61(4): 729–742. https://doi.org/10.1515/ap-2016-0102

Gusev VM, Guseva AA (1960) Habitats and places of mass reproduction of ticks *Ixodes frontalis* Panz. in Dagestan. Zoologicheskij Zhurnal 39(7): 1096–1099. [In Russian]

Guseva AA (1962) To the study of ixodid ticks in Stavropol Krai. Trudy Azerbaijanskoj Protivochumnoj Stancii 3: 228–235. [In Russian]

Haarløv N (1962) Variation in the ixodid tick, *Ixodes arboricola* Schulze & Schlottke 1929. Parasitology 52(3–4): 425–439. https://doi.org/10.1017/S0031182000027244

Hoogstraal H (1967) *Ixodes jacksoni* n. sp. (Ixodoidea: Ixodidae), a nest parasite of the spotted cormorant, *Phalacrocorax punctatus* (Sparrman), in New Zealand. Journal of Medical Entomology 4(1): 37–41. https://doi.org/10.1093/jmedent/4.1.37

Hoogstraal H (1970) Human infestation by ticks (Ixodidae) in the Himalaya. In: Sing KS, Tandan BK (Eds) HD Srivastava commemoration volume. Division of Parasitology of the Indian Veterinary Research Institute, Izatnagar, 75–89.

Ishiguro F, Takada N, Yano Y (2000) Ticks multi-infested on *Turdus pallidus* (Aves: Turdidae) and their *Borrelia* prevalence. Nihon Dani Gakkaishi 9(2): 189–192. https://doi.org/10.2300/acari.9.189

Ivanov AI (1945) Role of birds in circulation of ticks in nature. Trudy Tajikskogo Filiala AN SSSR 14: 43–52. [In Russian]

Jaenson TG, Jensen JK (2007) Records of ticks (Acari: Ixodidae) from the Faroe Islands. Norwegian Journal of Entomology 54(1): 11–15.

Jaenson TG, Värv K, Fröjdman I, Jääskeläinen A, Rundgren K, Versteirt V, Estrada-Peña A, Medlock JM, Golovljova IV (2016) First evidence of established populations of the taiga tick *Ixodes persulcatus* (Acari: Ixodidae) in Sweden. Parasites & Vectors 9(1): 1–8. https://doi.org/10.1186/s13071-016-1658-3

Kadatskaya KP, Shirova LF (1963) Ixodid ticks and fleas in the tuleremia focus of the Nakhichevan SSR. DAN AzSSR 19(4): 79–83. [In Russian]

Kadosaka T, Hasegawa J (1996) A case of human tick bite by *Ixodes turdus*. Nihon Dani Gakkaishi 5(1): 39–40. https://doi.org/10.2300/acari.5.39

Kahl O, Gray JS (2023) The biology of *Ixodes ricinus* with emphasis on its ecology. Ticks and Tick-Borne Diseases 14(2): 102–114. https://doi.org/10.1016/j.ttbdis.2022.102114

Kalita SR, Pelipeychenko MV (1957) To the knowledge of the fauna of ixodid ticks of Krasnodar Krai. Zoologicheskij Zhurnal 36(6): 947–948. [In Russian]

Kaluzhenkova ZP, Derevyanchenko KI, Pisarev YuA (1961) Species composition and number of ticks. Materialy Nauchnoj Konferencii Posvyaschennoj 40-letiju KazSSR, Alma-Ata, 67–68. [In Russian]

Kalyagin YS, Zubko KS, Bogdanov VR, Baranov EN (2005) Results of studies of parasite-host relations in ixodid ticks and warm-blooded vertebrates at the Department of Zoology and Ecology of Kemerovo State University. Trudy Kemerovskogo Otdelenija Russkogo Entomologicheskogo Obshhestva 3: 27–35. [In Russian]

Kalyagin YuS, Baranov EN, Bogdanov VR, Zubko KS (2008) Reactivity of integumentary tissues of underyearlings of the forest-steppe marmot when parasitizing females of the ixodid tick *Ixodes crenulatus* Koch. Trudy Kemerovskogo Otdelenija Russkogo Entomologicheskogo Obshhestva 6: 56–60. [In Russian]

Karpovich VN (1970) Properties of *Ceratixodes putus* Pick-Camb. parasitism on birds. Parazitologiia 4(4): 345–351. [In Russian]

Karpovich VN (1971) Distribution of the ixodid tick in Murman and the White Sea and the characterization of its contact with humans. In: Priroda I Hozjajstvo Severa. Vol. 2 (2). Apatity, 282–288. [In Russian]

Karpovich VN (1973) Life cycle of *Ceratixodes putus* Pick-Camb. in conditions of Murman. Parazitologiia 7(2): 128–134. [In Russian]

Keirans JE, Clifford CM (1978) The genus *Ixodes* in the United States: A scanning electron microscope study and key to adults. Journal of Medical Entomology. Supplement 2(suppl_2): 1–149. https://doi.org/10.1093/jmedent/15.suppl2.1

Keirans JE, Lacombe EH (1998) First Records of *Amblyomma americanum*, *Ixodes* (*Ixodes*) *dentatus*, and *Ixodes* (*Ceratixodes*) *uriae* (Acari: Ixodidae) from Maine. The Journal of Parasitology 84(3): 629–631. https://doi.org/10.2307/3284739

Kerbabaev EB (1960) About new for Turkmenistan tick species of the family Ixodidae. Izvestija AN TSSR. Serija biologicheskih nauk 5: 80–81. [In Russian]

Kerbabaev EB (1961) Materials on Ixodoidea ticks of Turkmenistan. In: Natural nidality of diseases and matters of parasitology. Izdatel'stvo AN KazSSR, Alma-Ata, 489–493. [In Russian]

Kerbabaev EB (2011) Ixodofauna of the Republic of Abkhazia and adjacent territories. Rossijskij Parazitologiceskij Zurnal 1: 18–26. [In Russian]

Keskin A, Selçuk AY (2021) A survey for tick (Acari: Ixodidae) infestation on some wild mammals and the first record of *Ixodes trianguliceps* Birula in Turkey. Systematic and Applied Acarology 26(12): 2209–2220. https://doi.org/10.11158/saa.26.12.1

Keve G, Sándor AD, Hornok S (2022) Hard ticks (Acari: Ixodidae) associated with birds in Europe: Review of literature data. Frontiers in Veterinary Science 9: 928756. https://doi.org/10.3389/fvets.2022.928756

Khametova AP, Pichurina NL, Zabashta MV, Romanova LV, Orekhov IV, Borodina TN, Adamenko VI, Zabashta AV (2018) Biocenotic structure of the natural focus of borelliosis in the Rostov region. Medicinskaja Parazitologiya I Parazitarnye Bolezni 4: 33–39. https://doi.org/10.33092/0025-8326mp2018.4.33-39 [In Russian]

Kharadov AV, Fedorova SJ, Kyzaibekova SA (2013) Muskrat (*Ondatra zibethicus* (L.)) in northern Kyrgyzstan is a component of natural foci of anthropozoonosis. Bulleten' Moskovskogo Obshhestva Estestvoispytatelej. Otdel Biologicheskij 118(3): 3–9. [In Russian]

Khitsova LN, Sherstyanykh EI (2014) The community of ectoparasites of the serotine bat *Eptesicus serotinus* (Schreber, 1774) in the Usmansky pine forest. Vestnik VGU. Seirja: Himija. Biologija. Farmacija 2: 66. [In Russian]

Kholodilov I, Belova O, Burenkova L, Korotkov Y, Romanova L, Morozova L, Kudriavtsev V, Gmyl L, Belyaletdinova I, Chumakov A, Chumakova N, Dargyn O, Galatsevich N, Gmyl A, Mikhailov M, Oorzhak N, Polienko A, Saryglar A, Volok V, Yakovlev A, Karganova G (2019) Ixodid ticks and tick-borne encephalitis virus prevalence in the South Asian part of Russia (Republic of Tuva). Ticks and Tick-Borne Diseases 10(5): 959–969. https://doi.org/10.1016/j.ttbdis.2019.04.019

Khudyakov IS (1963) Ectoparasites of mammals in the focus of hemorrhagic nephroso-nephritis. Trudy Voenno-Medicinskoj Ordena Lenina Akademii Imeni Kirova 149: 108–121. [In Russian]

Kidov AA, Timoshina AL, Matushkina KA, Kovrina EG (2013) Parasitism of European forest tick *Ixodes ricinus* (Linnaeus, 1758) (Acari, Parasitiformes: Ixodidae) on Brauner's lizard, *Darevskia brauneri* (Mehely, 1909) (Reptilia, Sauria: Lacertidae). Vestnik Burjatskogo Gosudarstvennogo Universiteta. Biologija. Geografija 4: 165–166. [In Russian]

Kim HC, Kim JH, Jo YS, Chong ST, Sames WJ, Klein TA, Robbins RG (2009a) Records of *Ixodes pomeranzevi* Serdyukova, 1941 (Acari: Ixodidae) from small mammals in northern Gyeonggi and Gangwon provinces, Republic of Korea. Systematic and Applied Acarology 14(2): 129–135. https://doi.org/10.11158/saa.14.2.4

Kim HC, Ko S, Choi CY, Nam HY, Chae HY, Chong ST, Klein TA, Sames WJ, Robbins RG, Chae JS (2009b) Migratory bird tick surveillance, including a new record of *Haemaphysalis ornithophila* Hoogstraal and Kohls 1959 (Acari: Ixodidae) from Hong-do (Hong Island), Republic of Korea. Systematic and Applied Acarology 14(1): 3–10. https://doi.org/10.11158/saa.14.1.1

Kim HC, Chong ST, Sames WJ, Nunn PV, Wolf SP, Robbins RG, Klein TA (2010) Tick surveillance of small mammals captured in Gyeonggi and Gangwon Provinces, Republic

of Korea, 2004–2008. Systematic and Applied Acarology 15(2): 100–108. https://doi.org/10.11158/saa.15.2.2

Kim HC, Han SH, Chong ST, Klein TA, Choi CY, Nam HY, Chae HY, Lee H, Ko S, Kang JG, Chae JS (2011) Ticks collected from selected mammalian hosts surveyed in the Republic of Korea during 2008–2009. Korean Journal of Parasitology 49(3): 331–335. https://doi.org/10.3347/kjp.2011.49.3.331

Kim HC, Chong ST, Suh JH, Yun SM, Lee WJ, Kim JH, Park CD, Kim DH, Kim HT, Kim H, Klein TA, Robbins RG (2018) *Ixodes nipponensis* Kitaoka and Saito and *Amblyomma testudinarium* Koch (Acari: Ixodida: Ixodidae) collected from reptiles (lizards, skinks, and snakes) in the Republic of Korea, 2016. Systematic and Applied Acarology 23(4): 757–767. https://doi.org/10.11158/saa.23.4.14

Kirillova NYu, Kirillov AA (2008a) Ectoparasites of insectivorous mammals (Insectivora) of the Samarskaya Luka. Samarskaja Luka: Problemy Regional'noj I Global'noj Ekologii 17(1): 91–97. [In Russian]

Kirillova NYu, Kirillov AA (2008b) Ectoparasites of rodents (Rodentia) of Samarskaya Luka. Izvestija Samarskogo Nauchnogo Centra Rossijskoj Akademii Nauk 10(2): 479–487. [In Russian]

Kirschenblatt JD (1936) Beitrage zur Palearktischen Zekenfauna. Zoologischer Anzeiger 114(3–4): 93–97.

Kitaoka S, Saito Y (1967) *Ixodes nipponensis* n. sp. (Ixodoidea, Ixodidae), a common cattle tick in Japan. Nain. Inst. Anim. Health Q 7(2): 74–83.

Kitrytė N, Baltrūnaitė L (2023) Ectoparasitic mites, ticks (Acari: Trombidiformes, Mesostigmata, Ixodida) and insects (Insecta: Psocodea, Siphonaptera) of ground-dwelling small mammals in the Baltic States. An annotated checklist. Zootaxa 5353(1): 1–46. https://doi.org/10.11646/zootaxa.5353.1.1

Ko JH, Cho DY, Chung BS, Kim SI (2002) Two human cases of tick bite caused by *Ixodes nipponensis*. Korean Journal of Parasitology 40(4): 199–203. https://doi.org/10.3347/kjp.2002.40.4.199

Koch CL (1844a) Systematische Übersicht über die Ordnung der Zecken. Archiv für Naturgeschichte 10(1): 217–239. https://doi.org/10.5962/bhl.part.29560

Koch CL (1844b) Deutschlands Crustaceen, Arachniden und Myriapoden. Part 37. Herausgegeben von Herrich-Schaäffer. Regensburg, no pagination.

Koch CL (1844c) Deutschlands Crustaceen, Arachniden und Myriapoden. Part 39. Herausgegeben von Herrich-Schaäffer, Regensburg, no pagination.

Kochkareva AV, Zagniborodova EN, Zhernovov IV, Zaitseva VI, Shilenko VI, Zabegalova MN, Avakov SM, Tashliev AO, Belskaya GS, Vazhev AP (1971) Distribution of Ixodoidea ticks in Turkmenistan. Izvestija AN TSSR. Serija Biologicheskih Nauk 5: 36–42.

Kolonin GV (1981) World distribution of ixodid ticks (genus *Ixodes*). Nauka, Moskva, 114 pp. [In Russian]

Kolonin GV (1986) Materials on the fauna of ixodid ticks in the south of Primorsky Krai. Parazitologiia 20(1): 15–18. [In Russian]

Kolonin GV (2008) Birds as hosts of ixodid ticks (Acarina, Ixodidae). Entomological Review 88(8): 1012–1015. https://doi.org/10.1134/S0013873808080150

Kolonin GV (2009) Fauna of ixodid ticks of the world. http://www.kolonin.org/

Korenberg EI, Kovalevsky YV (1977) General scheme of tick-borne encephalitis virus circulation. Zoologicheskij Zhurnal 56(10): 1467–1478. [In Russian]

Korenberg EI, Lebedeva NN, Zhukov VI (1974) Geographical variability and types of seasonal activity of adult *Ixodes persulcatus* P. Sch. Bulleten' MOIP. Otdelenie Biologii 79(4): 34–43. [In Russian]

Korenberg EI, Pomelova VG, Osin NS (2013) Natural-focal infections transmitted by Ixodidae ticks. Commentarij, Moscow, 463 pp. [In Russian]

Korenberg EI, Kovalevsky YV, Gorelova NB, Nefedova VV (2015) Comparative analysis of the roles of *Ixodes persulcatus* and *I. trianguliceps* ticks in natural foci of ixodid tick-borne borrelioses in the Middle Urals, Russia. Ticks and Tick-Borne Diseases 6(3): 316–321. https://doi.org/10.1016/j.ttbdis.2015.02.004

Korenberg EI, Sirotkin MB, Kovalevsky YV (2016) General scheme of the circulation of pathogens of ixodid tick-borne borreliosis in natural foci of Eurasia. Zoologicheskij Zhurnal 95(3): 283–299. [In Russian]

Korenberg EI, Sirotkin MB, Kovalevsky YV (2021) Adaptive features of the biology of closely related species of ixodid ticks that determine their distribution (illustrated on the example of the taiga tick *Ixodes persulcatus* Sch. 1930 and the castor bean tick *Ixodes ricinus* L. 1758). Biology Bulletin Reviews 11(6): 602–615. https://doi.org/10.1134/S2079086421060050

Korneev MG, Porshakov AM, Yakovlev SA (2018) First finding of *Ixodes lividus* Koch, 1844 (Ixodidae) in Saratov Province. Entomologicheskie I Parazitologicheskie Issledovanija V Povolzh'e 15: 76–77. [In Russian]

Korotkov YuS (2008) Variability of the life cycle duration in the taiga tick from mixed coniferous-broad-leaved forests of the Udmurt Republic. Parazitologiia 42(4): 264–271. [In Russian]

Korotkov Y, Kozlova T, Kozlovskaya L (2015) Observations on changes in abundance of questing *Ixodes ricinus*, castor bean tick, over a 35 year period in the eastern part of its range (Russia, Tula region). Medicinskaja I Veterinarnaja Entomologija 29(2): 129–136. [In Russian] https://doi.org/10.1111/mve.12101

Kovalev SY, Mikhaylishcheva MS, Mukhacheva TA (2015) Natural hybridization of the ticks *Ixodes persulcatus* and *Ixodes pavlovskyi* in their sympatric populations in Western Siberia. Infection, Genetics and Evolution 32: 388–395. https://doi.org/10.1016/j.meegid.2015.04.003

Kovalev SY, Golovljova IV, Mukhacheva TA (2016) Natural hybridization between *Ixodes ricinus* and *Ixodes persulcatus* ticks evidenced by molecular genetics methods. Ticks and Tick-Borne Diseases 7(1): 113–118. https://doi.org/10.1016/j.ttbdis.2015.09.005

Kovalev SY, Fedorova SJ, Mukhacheva TA (2018) Molecular features of *Ixodes kazakstani*: First results. Ticks and Tick-Borne Diseases 9(3): 759–761. https://doi.org/10.1016/j.ttbdis.2018.02.019

Kovalevsky AV, Zubko KS, Efimova AR, Luchnikova EM, Drozdova OM (2018) Distribution and some biological features of ixodid ticks (Parasitiformes, Ixodidae) in Kuznetsk-Salair mountain area (Kemerovo province, Russia). Entomological Review 98(9): 1379–1388. https://doi.org/10.1134/S0013873818090154

Kovalevsky AV, Ilyashenko VB, Luchnikova EM, Vdovina ED, Teplova NS (2019) Sand martin *Riparia* of the Kuznetsk-Salair Mountain Area (Kemerovo Area, Russia). IOP Conference Series. Earth and Environmental Science 224(1): 012028. https://doi.org/10.1088/1755-1315/224/1/012028

Kozlova TV, Dorofeev EM, Smol'yaninova OL, Popov VP (2014) Distribution, abundance, and epidemiological significance of *Ixodes ricinus* ticks in the territory of the Tula region. Problemy Osobo Opasnyh Infekcij 2: 58–61. https://doi.org/10.21055/0370-1069-2014-2-58-61 [In Russian]

Kozlovskaya OL, Chernyh PA, Koshkin SM (1968) New and little known species of ectoparasites in Khabarovsk Krai. Izvestiya Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta Sibiri I Dal'nego Vostoka 27: 312–315. [In Russian]

Kravchenko OV (2014) Species diversity of ixodid ticks (Acarina: Ixodidae) in some recreational areas of the Republic of Moldova. In: Sustainable use and protection of animal world diversity, 139–140. [In Russian]

Kuklina TE (1967) Features of distribution of ixodid ticks in Uzbekistan. In: Poleznye I Vrednye Bespozvonochnye Zhivotnye Uzbekistana. Fan, Tashkent, 108–112. [In Russian]

Kuznetsov VL, Bondarev VY (2007) Distribution of ticks (Ixodidae) in the Lugansk region. ZOOCENOSIS–2007. Biodiversity and the role of animals in ecosystems. IV International Scientific Conference. Ukraine, Dnipropetrovsk, DNU, 343. [In Russian]

Lamontellerie M (1954) *Ixodes sigalasi* n. sp., ixodoide nouveau des oiseaux. Annales de Parasitologie Humaine et Comparee 29(5–6): 561–567. https://doi.org/10.1051/parasite/1954295561 [In French]

Latreille PA (1795) Observations sur la variété des organs de la bouche des tiques, et distribution méthodique des insectes de cette famille d'après les caractères établis sur la conformation de ces organes. Magasin Encyclopédique ou Journal des Sciences, des Lettres et des Arts, Paris 4: 15–20.

Leach WE (1815) A tabular view of the external characters of four classes of animals, which Linné arranged under Insecta: With the distribution of the genera composing three of these classes into orders, and descriptions of several new genera and species. Transactions of the Linnean Society of London 11(2): 306–400. https://doi.org/10.1111/j.1096-3642.1813.tb00065.x

Leonova GN, Lvov DK, Chervonsky VI, Tsirkin YuM, Belikova NP, Shestakov VI, Shibaev YuV, Yudakov AG, Sazonov AA (1971) Serological and parasitological survey of seabirds on Furugelm Island (Rimsky-Korsakov Archipelago). In: Materialy 4 Symposiuma Po Izucheniju Virusov Ecologicheski Svyazannyh S Ptitsami. Omsk, 54. [In Russian]

Levit AW (1957) Ticks of the superfamily Ixodoidea of the Northern Caspian. Trudy Instituta Zoologii AN KazSSR 7: 15–58. [In Russian]

Levytska V, Mushinsky AB, Zubrikova D, Blanarova L, Długosz E, Vichova B, Slivinska KA, Gajewski Z, Gizinski S, Liu Sh, Zhou L, Rogovskyy AS (2021) Detection of pathogens in ixodid ticks collected from animals and vegetation in five regions of Ukraine. Ticks and Tick-Borne Diseases 12(1): 101586. https://doi.org/10.1016/j.ttbdis.2020.101586

Linnaeus C (1758) Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Vol. 1. Editio decima, reformata. Impensis Direct. Laurentii Salvii, Holmiae, 823 pp. https://doi.org/10.5962/bhl.title.542

Litvinov YuN, Sapegina VF (2003) Ectoparasites of the zokor *Myospalax myospalax* (Rodentia) in Northern Altai. Parazitologiia 37(2): 103–106. [In Russian]

Loseva EI (1963) Ixodid ticks. Trudy Instituta Zoologii AN Kaz SSR 19: 180–190. [In Russian]

Lotozky BV (1945) Materials on the fauna and biology of ticks of the superfamily Ixodidae in the Hisar Valley of Tajikistan in relation to the justification of measures for the prevention of piroplasmosis in cattle. Trudy Tajikskogo Filiala AN SSSR 14: 69–120. [In Russian]

Lotozky BV (1951) Ixodid ticks. In: Pavlovsky EN, Zhadin VI (Eds) Uschel'e Kondara. Izdatel'stvo AN SSSR, Moskva, Leningrad, 217–224. [In Russian]

Lotozky BV (1956) A new species of the genus *Ixodes*, *I. cornutus* Lot. sp. n., in the Mountains of Tajikistan. DAN TajSSR 19: 27–29. [In Russian]

Luh PL, Woo WC (1950) A list of Chinese ticks. Acta Entomologica Sinica 1: 195–222.

Lutta AS (1968) *Ixodes trianguliceps* Bir. and its distribution in Karelia. Parazitologiia 11(2): 142–150. [In Russian]

Lutta AS (1976) Prevalence and ecology of *Ixodes apronophorus* P. Sch. in Karelia. Medicinskaja Parazitologiya I Parazitarnye Bolezni 45(4): 455–460. [In Russian]

Lvov DK, Timofeeva AA, Gromashevski VL, Chervonsky VI, Gromov AI, Tsyrkin YM, Pogrebenko AG, Kostyrko IN (1972a) "Sakhalin" virus – a new arbovirus isolated from *Ixodes* (*Ceratixodes*) *putus* Pick.-Camb. 1878 collected on Tuleniy island, Sea of Okhotsk. Archives of Virology 38(2–3): 133–138. https://doi.org/10.1007/BF01249662

Lvov DK, Chervonski VI, Gostinshchikova IN, Zemit AS, Gromashevski VL, Tsyrkin YM, Veselovskaya OV (1972b) Isolation of the Tyulenyi virus from ticks *Ixodes* (*Ceratixodes*) *putus* Pick.-Camb. 1878 collected on Commander Islands. Archives of Virology 38(2–3): 139–142. https://doi.org/10.1007/BF01249663

Lvov DK, Timopheeva AA, Smirnov VA, Gromashevsky VL, Sidorova GA, Nikiforov LP, Sazonov AA, Andreev AP, Skvortzova TM, Beresina LK, Aristova VA (1975) Ecology of tick-borne viruses in colonies of birds in the USSR. Medical Biology 53(5): 325–330.

Lvov DK, Al'khovskiĭ SV, Shchelkanov MYu, Shchetinin AM, Deryabin PG, Samokhvalov EI, Gitelman AK, Botikov AG (2014) Genetic characterization of viruses from the antigenic complex Tyuleniy (Flaviviridae, Flavivirus): Tyuleniy virus (TYUV) (ID GenBank KF815939) isolated from ectoparasites of colonial seabirds—*Ixodes* (*Ceratixodes*) *uriae* White, 1852, ticks collected in the high latitudes of Northern Eurasia—and Kama virus (KAMV) isolated from the *Ixodes lividus* Roch, 1844, collected in the digging colonies of the middle part of Russian plane. Voprosy Virusologii 59(1): 18–24. [In Russian]

Lvov DK, Alkhovskiy SV, Shchelkanov MI, Shchetinin AM, Deriabin PG, Aristova VA, Gitel'man AK, Samokhvalov EI, Botikov AG (2014b) Genetic characterization of Sakhalin virus (SAKV), Paramushir virus (PMRV) (Sakhalin group, Nairovirus, Bunyaviridae) and Rukutama virus (RUKV) (Uukuniemi group, Phlebovirus, Bunyaviridae), isolated from the obligate parasites of colonial sea-birds - ticks *Ixodes* (*Ceratixodes*) *uriae*, White 1852 and *I. signatus* Birulya, 1895 in water area of sea of Okhotsk and Bering sea. Voprosy Virusologii 59(3): 11–17. [In Russian]

Lyashko GL (1973) The ecology of the tick *Ixodes kazakstani* Ol. et Sor. Seasonal course of tick activity. Medicinskaja Parazitologiya I Parazitarnye Bolezni 42(1): 36–39. [In Russian]

Maikanov NS (2012) Epidemiological significance of ixodid ticks in Kazakhstan. In: Meldebekov AM (Ed.) Materialy Mezhdunarodnoj nauchnoj konferencii «Zhivotnyj Mir Kazahstana I Sopredel'nyh Territorij». Institut Zoologii, Almaty, 134–135. [In Russian]

Makhmetov MM (1961) Spontaneous infection of *Rickettsia burneti* in ectoparasites of the sand martin. In: Prirodnaja Ochagovost' Boleznej i Voprosy Parazitologii. Vol. 3. Izdatel'stvo AN KazSSR, Alma-Ata, 70–74. [In Russian]

Mal'kova MG, Bogdanov II (2004) Parasite fauna of the water vole (*Arvicola terrestris*) and its nests in the south of Western Siberia. Parazitologiia 38(1): 33–45. [In Russian]

Manilova EA, Shakhmatov GN (2008) Parasite fauna of wild and domestic animals of the reserve "Tigrovaya Balka". Izvestija Akademii Nauk Respubliki Tadzhikistan. Otdelenie Biologicheskih I Medicinskih Nauk 3: 50–56. [In Russian]

Martyn KP (1998) Provisional atlas of the ticks (Ixodoidea) of the British Isles. Biological Records Centre, Institute of Terrestrial Ecology, Natural environment Research Council, Swindon, United Kingdom, 62 pp.

Marutyan EM (1963) Fauna of ixodid ticks in the Chechen-Ingush Autonomous Soviet Socialist Republic. Trudy Vsesojuznogo Instituta Eksperimental'noj Veterinarii 28: 9–97. [In Russian]

Maslennikova ZP, Stogov II (1974) Materials on ecology of *Ixodes* (*Pholeoixodes*) *subterranus* Filippova, 1961 in the north-east of the Tien Shan. In: Materialy 7 Nauchnoj Konferencii Protivochumnuh Uchrezhdenij Srednej Azii I Kazahstana, Alma-Ata, 335–336. [In Russian]

Maslennikova ZG, Ushakova GV (1971) To the ecology of the tick *Ixodes occultus*. In: Materialy 7 Nauchnoj Konferencii Protivochumnuh Uchrezhdenij Srednej Azii I Kazahstana. Alma-Ata, 402–404. [In Russian]

Maslennikova ZG, Morozova NV, Bibikova VA (1964) Ticks of the superfamily Ixodoidea of mammals of the Saryesik-Atyrau Desert. Trudy Instituta Zoologii AN KazSSR 2: 166–173. [In Russian]

Matyukhin AV (2017) Ixodid ticks (Ixodidae) of the North-Western Black Sea. Rossijskij Parazitologiceskij Zurnal 4(42): 334–338. [In Russian]

Mayorova AD (2004) Some results of the study of ectoparasites (ixodid ticks, gamasid mites, fleas and lice) in the Ivanovo Oblast. Vestnik Ivanovskogo Gosudarstvennogo Universiteta 3: 8–12. [In Russian]

Medvedev SG, Shapar AO, Grigorieva LA, Osipova TN, Samoilova EP (2016) Biological risks of the development of St. Petersburg and Leningrad province agglomeration. Uchenye Zapiski Rossijskogo Gosudarstvennogo Gidrometeorologicheskogo Universiteta 43: 223–235. [In Russian]

Milintsevich AV, Abramov AV, Kuvshinova PS (2016) Species composition of ixodid ticks parasitizing on dogs in the city of Yekaterinburg. Molodezh'. I Nauka 5: 1–1. [In Russian]

Morel PC, Aubert MFA (1975) Contribution à la connaissance de *Pholeoixodes rugicollis* (Schulze et Schlotkke, 1929) (Acariens, Ixodina). Cahiers de l'Office de la Recherche Scientifique et Technique Outremer. Série Entomologie Medicale et Parasitologie 13: 99–109. [In French]

Morel PC, Perez C (1978) Morphologie des stages préimaginales des Ixodidae s. str. d'Europe occidentale. IV. Généralité sur le sous-genre *Ixodes* (*Ixodes*). Acarologia 19: 201–208. [In French]

Morozov A, Proka A (2012) Ticks (Acari, Ixodidae) on indigenous and migratory birds in Chishinau. In: International Conference of Young Researchers. Scientific Abstracts. 10th ed. Chisinau, Moldova, 47.

Morozov A, Tischenkov A, Silaghi C, Proka A, Toderas I, Movila A, Frickmann H, Poppert S (2022) Prevalence of bacterial and protozoan pathogens in ticks collected from birds in the Republic of Moldova. Microorganisms 10(6): 1111. https://doi.org/10.3390/microorganisms10061111

Moskvitina NS, Korobitsyn IG, Tyuten'kov OY, Gashkov SI, Kononova YV, Moskvitin SS, Romanenko VN, Mikryukova TP, Protopopova EV, Kartashov MY, Chausov EV, Konovalova SN, Tupota NL, Sementsova AO, Ternovoi VA, Loktev VB (2014) The role of birds in the maintenance of tick-borne infections in the Tomsk anthropurgic foci. Biology Bulletin of the Russian Academy of Sciences 41(4): 387–393. https://doi.org/10.1134/S1062359014040086

Mosolov LP (1961) Records of *Ixodes apronophorus* P. Sch. in the Moscow region and observations in a natural focus of tularaemia. Medicinskaja Parazitologiya I Parazitarnye Bolezni 30(3), 304–305, 379. [In Russian]

Movila A, Gatewood A, Toderas I, Duca M, Papero M, Uspenskaia I, Conovalov Y, Fish D (2008) Prevalence of *Borrelia burgdorferi* sensu lato in *Ixodes ricinus* and *I. lividus* ticks collected from wild birds in the Republic of Moldova. International Journal of Medical Microbiology 298: 149–153. https://doi.org/10.1016/j.ijmm.2007.12.009

Muratbekov YM (1954) To the question of zoogeography of ixodid ticks in the Tashkent region. Trudy Instituta Zoologii I Parasitologii AN UzSSR 3: 7–16. [In Russian]

Musaev ZG, Abdulmagomedov SSh, Begieva SA, Bittirov AM (2019) Epidemiological significance of ixodid ticks in the plain, foothill and mountain zones of Dagestan. Teorija I Praktika Bor'by S Parazitarnymi Boleznjami 20: 384–387. https://doi.org/10.31016/978-5-9902340-8-6.2019.20.384-387 [In Russian]

Myasnikov YuA, Katelina AF (1964) Data on the distribution and phenology of ticks in the Tula region. Medicinskaja Parazitologiya I Parazitarnye Bolezni 33(3): 357–360. [In Russian]

Nakao M, Miyamoto K, Kitaoka S (1992) A new record of *Ixodes pavlovskyi* Pomerantzev from Hokkaido, Japan (Acari: Ixodidae). Japanese Journal of Sanitary Zoology 43(3): 229–234. https://doi.org/10.7601/mez.43.229

Nakatsudi K (1942) Arachnida from Izu-Shitito. Journal of Agricultural Science 1: 287–328.

Nakatsukase A, Hatsushika R (1985) A case report on the human infestation by a hard tick *Ixodes nipponensis* found in Okayama, Japan (Acarina: Ixodidae). Kawasaki Medical Journal 11(4): 225–231. https://doi.org/10.11482/KMJ-E11(4)225

Nebogatkin IV (1993) About the absence of the taiga tick (*Ixodes persulcatus*) and the disappearance of *Boophilus annulatus* in Ukraine. Vestnik Zoologii 2: 76–78. [In Russian]

Nebogatkin IV (1998) Rare, disappearing and occasionally occurred species of ixodid ticks (Parasitiformes, Ixodidae) in Ukraine. Vestnik Zoologii 32: 143–147. [In Russian]

Nebogatkin IV (2014) Birds as the feeders of ticks (Acari, Ixodida) in megalopolis of Kyiv. Vestnik Zoologii 48(5): 467–470. https://doi.org/10.2478/vzoo-2014-0055

Nelzina EN, Slinko LI, Kadatskaya KP, Ivanov KA, Yamschikova KhG, Poltavtsev NN, Skirda GI (1955) Ixodid ticks (Parasitiformes, family Ixodidae) of rodents of the northwestern Caspian region. Trudy Astrahanskoj Protivochumnoj Stancii 1: 416–433. [In Russian]

Neumann LG (1899) Révision de la famille des ixodidés (3e mémoire). Mémoires de la Société Zoologique de France 12: 107–294. [In French]

Neumann LG (1901) Révision de la famille des ixodidés (4e mémoire). Mémoires de la Société Zoologique de France 14: 249–372. [In French]

Neumann LG (1902) Notes sur les Ixodides. I. Archives de Parasitologie 6: 109–128.

Neumann LG (1904) Notes sur les ixodidés. II. Archives de Parasitologie 8: 444–464. [In French]

Neumann LG (1906) Notes sur les Ixodidés. IV. Archives de Parasitologie 10: 195–219.

Neumann LG (1908) Notes sur les Ixodidés. VI. Archives de Parasitologie 12: 5–27.

Neumann LG (1911) Ixodidae. Das Tierreich 26: 1–169. https://doi.org/10.5962/bhl.title.22339 [In German]

Nikitchenko NT (2011) Ectoparasites of the European mole (*Talpa europaea* L.) in the conditions of the central forest-steppe of Ukraine. Priroda Zahidnogo Polissja ta prileglih teritorij 8: 168–173. [In Russian]

Nikitin AY, Verzhutskaya YA, Morozov IM, Gordeyko NS (2021) Exoskeletal anomalies in *Ixodes pavlovskyi pavlovskyi* (Parasitiformes, Ixodidae). Entomological Review 101(9): 1434–1440. https://doi.org/10.1134/S0013873821090207

Numan M, Islam N, Adnan M, Zaman Safi S, Chitimia-Dobler L, Labruna MB, Ali A (2022) First genetic report of *Ixodes kashmiricus* and associated *Rickettsia* sp. Parasites & Vectors 15(1): 1–12. https://doi.org/10.1186/s13071-022-05509-y

Nuttall GHF (1910) New species of ticks (*Ixodes*, *Amblyomma*, *Rhipicephalus*). Parasitology 3(4): 408–416. https://doi.org/10.1017/S0031182000002249

Nuttall GHF, Warburton C (1911) Ticks. A monograph of the Ixodoidea. Part II. The Ixodidae. Section II. Genus I. *Ixodes* Latreille 1795. Cambridge University Press, London, UK, 133–293. https://doi.org/10.5962/bhl.title.24075

Oberth AS, Kurepina NY, Bezrukov GV, Merkushev OA, Cherkashina EN, Kalinina UV (2015) Ixodid ticks as carriers of human transmissible infectious diseases in the Altai Territory. Izvestija Altajskogo Otdelenija Russkogo Geograficheskogo Obshhestva 2(37): 82–89. [In Russian]

Ogandzhanyan AM (1949) On the finding of *Ixodes vespertilionis* Koch, 1844 (Acarina Ixodidae) in the Armenian SSR. DAN ArmSSR 10(5): 219–221. [In Russian]

Ogandzhanyan AM (1959) Some data on the morphology and ecology of the tick *Ixodes eldaricus* Djap. (Ixodoidea). Izvestija AN ArmSSR. Serija Biologicheskih Nauk 12(7): 73–77. [In Russian]

Ogandzhanyan AM (1960) Rodents, birds and reptiles as hosts of ixodid ticks in the conditions of the Armenian SSR and adjacent regions of the Azerbaijani SSR. Trudy Armyanskoj Protivochumnoj Stancii 1: 383–389. [In Russian]

Ogandzhanyan AM (1984) New species of ixodid ticks for the fauna of Armenia. Parazitologiia 18: 181–182. [In Russian]

Okino T, Ushirogawa H, Matoba K, Hatsushika R (2010) Bibliographical studies on human cases of hard tick (Acarina: Ixodidae) bites in Japan (6) Cases of infestation with rare tick species. Kawasaki Medical Journal 36(2): 121–126.

Okulova NM, Judaev ON, Konstantinov OK (1986) On the ecology of the tick *Ixodes pomerantzevi* (Ixodidae). Parazitologiia 20(1): 11–14. [In Russian]

Olenev NO (1927) On the taxonomy and geographical distribution of ticks. DAN SSSR (A) 14: 219–224. [In Russian]

Olenev NO (1929a) On the taxonomy and geographical distribution of ticks (Ixodoidea): IV. DAN SSSR (A) 21: 489–494. [In Russian]

Olenev NO (1929b) The study of the Ixodoidea of our country. Vestnik Sovremennoy Veterinarii 5: 191–193. [In Russian]

Olenev NO (1931a) Parasitic ticks Ixodoidea of the fauna of the USSR. Key identification of the fauna of the USSR, Vol. 4. Izdatel'stvo AN SSSR, Leningrad, 125 pp. https://doi.org/10.1007/BF02122052 [In Russian]

Olenev NO (1931b) Die Zecken (Ixodoidea) der Fauna Russlands. Parasitology Research 4(1): 126–139. https://doi.org/10.1007/BF02122052 [In German]

Olenev NO, Sorokoumov GI (1934) A new species of the genus *Ixodes* from Southwestern Kazakhstan. Vestnik Mikrobiologii 13(1): 73–75. [In Russian]

Oliver Jr JH, McKeever S, Pound JM (1986) Parasitism of larval *Ixodes* ticks by chigger mites and fed female *Ornithodoros* ticks by *Ornithodoros* males. The Journal of Parasitology 72(5): 811–812. https://doi.org/10.2307/3281492

Omeri ID, Moysak OD (2013) Medical and biological aspects of *Ixodes* ticks in the territory of Ukraine. Innovacijnij Potencial Ukraïns'koï Nauki – XXI Storichchja (Elektronnij resurs), 20. http://nauka.zinet.info/konf_20.php [In Russian]

Orkun Ö, Karaer Z (2018) First record of the tick *Ixodes* (*Pholeoixodes*) *kaiseri* in Turkey. Experimental & Applied Acarology 74(2): 201–205. https://doi.org/10.1007/s10493-018-0219-1

Orlova MV, Kapitonov VI, Grigoriev AK, Orlov OL (2011) Ectoparasites of bats of the Udmurt Republic. Vestnik Udmurtskogo Universiteta. Serija «Biologija. Nauki o Zemle» 21(2): 134–138. [In Russian]

Orlova MV, Doronin IV, Klimov PB, Anisimov NV (2022) A review of mites and ticks parasitizing rock lizards (Lacertidae: *Darevskia*). Journal of Vector Ecology 47(1): 19–28. https://doi.org/10.52707/1081-1710-47.1.19

Orlova MV, Doronin IV, Doronina MA, Anisimov NV (2023) A review of ixodid ticks (Acari: Ixodidae) associated with *Lacerta* spp. (Reptilia: Lacertidae) from the Caucasus and adjacent territory. Diversity 15(9): 1026. https://doi.org/10.3390/d15091026

Oudemans AC (1896) List of Dutch Acari Latr. Third part: Ricinae Latr. with synonymical, biological and other notes. Tijdschrift voor Entomologie 39: 191–197.

Paik SC, Oh YJ, Kim SY, Cho BK, Houh W (1989) A case of tick bite caused by *Ixodes nipponensis*. Korean Journal of Dermatology 27: 83–88.

Panzer GWF (1798) Fauna Insectorum Germanicae Initia, oder Deutschlands Insecten (Part 59) Nuremberg, Germany, 24 pp.

Paramonov BB, Emelyanova ND, Zarubina VN, Kontrimavitchus VL (1966) Materials for the study of ectoparasites of rodents and shrews of the Kamchatka peninsula. Izvestiya Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta Sibiri I Dal'nego Vostoka 26: 333–341. [In Russian]

Paulauskas A, Radzijevskaja J, Turčinavičienė J, Ambrasienė D, Galdikaitė E (2010) Data on some Ixodid tick species (Acari, Ixodidae) in the Baltic countries. New and rare for Lithuania insect species. Records and Descriptions 22: 43–51.

Peavey CA, Lane RS, Damrow T (2000) Vector competence of *Ixodes angustus* (Acari: Ixodidae) for *Borrelia burgdorferi* sensu stricto. Experimental & Applied Acarology 24(1): 77–84. https://doi.org/10.1023/A:1006331311070

Perfilyeva YV, Shapiyeva ZZ, Ostapchuk YO, Berdygulova ZA, Bissenbay AO, Kulemin MV, Ismagulova GA, Skiba YA, Sayakova ZZ, Mamadaliyev SM, Maltseva ER, Dmitrovskiy AM (2020) Tick-borne pathogens and their vectors in Kazakhstan – a review. Ticks and Tick-Borne Diseases 11(5): 1–10. https://doi.org/10.1016/j.ttbdis.2020.101498

Péter Á, Barti L, Corduneanu A, Hornok S, Mihalca AD, Sándor AD (2021) First record of *Ixodes simplex* found on a human host, with a review of cases of human infestation by bat tick species occurring in Europe. Ticks and Tick-Borne Diseases 12(4): 101722. https://doi.org/10.1016/j.ttbdis.2021.101722

Petrov VG, Bebeshko SV, Kulik IL (1967) On the fauna, distribution, population and ecology of ixodid ticks in the Chuvash ASSR. Zoologicheskij Zhurnal 46(2): 208–212. [In Russian]

Petukhov VA, Starikov VP, Vershinin EA, Morozkina AV, Sarapultseva ES, Kravchenko BN (2018) Structure of small mammal communities and their ectoparasites in the Surgut city. Ekologija Urbanizirovannyh Territorij (3): 19–24. https://doi.org/10.24411/1816-1863-2018-13019 [In Russian]

Podobivskyi SS, Fedonyuk LY (2017) On the issue of species composition, biology, and significance of ixodid ticks of Western Ukraine. Naukovi Zapiski Ternopil's'kogo Nacional'nogo Pedagogichnogo Universitetu Im. V. Gnatjuka. Ser. Biologija 2(69): 123–128. [In Ukrainian]

Pogodina VV [Ed.] (2021) Evolution of tick-borne encephalitis (from the discovery of the pathogen to the present). LLC «TFP», Tver, 344 pp.

Pomerantsev BI (1946) Ticks (Family Ixodidae) of the USSR and adjacent countries. Keys to the Fauna of the USSR. Vol. 26. Nauka, Moskva, Rossia, 28 pp. [In Russian]

Pomerantsev BI (1948) New ticks of the family Ixodidae. Parazitologicheskij Sbornik ZIN AN SSSR 10: 20–24. [In Russian]

Pomerantsev BI (1950) Ixodid ticks (Ixodidae). In: Fauna SSSR, Paukoobraznye 4(2): 1–224. [In Russian]

Popov VM (1967) About the fauna of ixodid ticks (Ixodidae) of the Tyumen Oblast. Zoologicheskij Zhurnal 66(2): 200–207. [In Russian]

Popov VP, Mezentsev VM, Antonov AV, Shkurin GP, Bezsmertny VE, Lopatin AA (2019) Landscape-epidemiological zoning of the Krasnodar Territory and the Republic of Adygea by tularemia. Problemy Osobo Opasnyh Infekcij 2: 105–110. https://doi.org/10.21055/0370-1069-2019-2-105-110 [In Russian]

Popova AS, Sokolova AA (1963) To the fauna of ixodid ticks in the Moiynkum Desert. In: Materialy Nauchnoj Konferencii Po Prirodnoj Ochagovosti I Profilaktike Chumy. Alma-Ata, 190–191. [In Russian]

Porshakov AM, Korneev MG, Matrosov AN (2020) Historical aspects of studies of the Ixodida order ticks found in the Saratov region. Medicinskaja Parazitologiya I Parazitarnye Bolezni 1: 42–52. https://doi.org/10.33092/0025-8326mp2020.1.42-52 [In Russian]

Randolph SE (1975) Patterns of distribution of the tick *Ixodes trianguliceps* Birula on its hosts. Journal of Animal Ecology 44(2): 451–474. https://doi.org/10.2307/3606

Rapoport LP, Kulemin MV, Melnichuk EA, Kobeshova ZhB, Shokputov TM, Atovullaeva LM, Sailaubekuly R (2017) Ixodoid ticks on rodents in the deserts of South Kazakhstan. Entmological Review 97(7): 970–974. https://doi.org/10.1134/S0013873817070119

Rar VA, Epikhina TI, Tikunova NV, Bondarenko EI, Ivanov MK, Yakimenko VV, Mal'kova MG, Tantsev AK (2014) DNA detection of pathogens transmitted by ixodid ticks in blood of small mammals inhabiting the forest biotopes in Middle Irtysh Area (Omsk Region, West Siberia). Parazitologia 48(1): 37–53.

Rar VA, Livanova N, Sabitova Y, Igolkina Y, Tkachev S, Tikunov A, Babkin I, Golovljovaa I, Panov V, Tikunova N (2019) *Ixodes persulcatus/pavlovskyi* natural hybrids in Siberia: Occurrence in sympatric areas and infection by a wide range of tick-transmitted agents. Ticks and Tick-Borne Diseases 10(6): 101254. https://doi.org/10.1016/j.ttbdis.2019.05.020

Rar VA, Yakimenko V, Tikunov A, Vinarskaya N, Tancev A, Babkin I, Epikhina T, Tikunova N (2020) Genetic and morphological characterization of *Ixodes apronophorus* from Western Siberia, Russia. Ticks and Tick-Borne Diseases 11(1): 101284. https://doi.org/10.1016/j.ttbdis.2019.101284

Ravkin ES (1969) Lizards as hosts of *Ixodes persulcatus* P. Sch. in north-eastern Altai. In: Cherepanov AI (Ed.) Pereletnye Pticy I Ih Rol' V Rasprostranenii Arbovirusov. Nauka, Novosibirsk, 170–173. [In Russian]

Reznik PA (1950) Zoogeographic notes (pasture ticks of the family Ixodidae). Medicinskaja Parazitologiya I Parazitarnye Bolezni 19(6): 525–526. [In Russian]

Reznik PA (1958) A new species of tick *Ixodes gussevi* sp. n. from Azerbaijan. Zoologicheskij Zhurnal 37(3): 457–458. [In Russian]

Reznik PA (1961) Contribution to study of immature stages of the tick family Ixodidae. Communication 6. Description of *Ixodes frontalis* Panz. larvae and nymphs and *Ixodes redikorzevi* 01. larvae. Trudy Nauchno-Issledovatel'skogo Protivochumnogo Instituta Kavkaza I Zakavkaz'ja 5: 276–286. [In Russian]

Romanenko VN (2011) Long-term dynamics of population density and species composition of pasture ixodid ticks (Parasitiformes, Ixodidae) in anthropogenic and natural areas. Entomological Review 91(9): 1190–1195. https://doi.org/10.1134/S0013873811090132

Romanenko VN, Leonovich SA (2015) Long-term monitoring and population dynamics of ixodid ticks in Tomsk city (Western Siberia). Experimental & Applied Acarology 66(1): 103–118. https://doi.org/10.1007/s10493-015-9879-2

Romashin AV (2021) Monitoring of dynamics bat species diversity in Sochi National Park. Trudy Mordovskogo Gosudarstvennogo Prirodnogo Zapovednika Im. P. G. Smidovicha 29: 368–382. [In Russian]

Rosický B, Weiser J (1952) Family Ixodidae - Ticks. In: Pests of Human Health II. Natural Sciences, Prague, Czech Republic, 512–582.

Rusev IT (2008) Ixodid ticks of the Northwestern Black Sea region and their role in the circulation of pathogens of natural focal arbovirus infections. Visnik Sums'kogo Derzhavnogo Universitetu 2(1): 82–100. [In Russian]

Rusev IT (2009) Species structure, number and biotope distribution of ticks in the north-western coast of the Black Sea. Visnik Odes'kogo Nacional'nogo Universitetu. Biologija 14(14): 89–101. [In Russian]

Ruzsky MO (1929) About some species of ticks at the resort "Karachi". Omskij Medicinskij Zhurnal 3–4: 146–149. [In Russian]

Ryu JS, Lee JU, Ahn MH, Min DY, Ree HI (1998) A human case of tick bite by *Ixodes nipponensis*. Korean Journal of Parasitology 36(1): 59–61. https://doi.org/10.3347/kjp.1998.36.1.59

Sabitova Y, Rar V, Tikunov A, Yakimenko V, Korallo-Vinarskaya N, Livanova N, Tikunova N (2023) Detection and genetic characterization of a putative novel *Borrelia* genospecies in *Ixodes apronophorus*/*Ixodes persulcatus*/*Ixodes trianguliceps* sympatric areas in Western Siberia. Ticks and Tick-Borne Diseases 14(1): 102075. https://doi.org/10.1016/j.ttbdis.2022.102075

Sandzhiev VK, Podsvirov AV, Knyazeva TV, Yashkulov KB, Popov NV, Sangadzhieva GV, Zhukovskaya AP, Kostina EV (2006) Concerning natural focality of Crimean hemorrhagic fever in the Republic of Kalmykia. Problemy Osobo Opasnykh Infektsii 1: 28–30. [In Russian]

Santos Dias JAT (1961) Mais alguns ixodídeos do Museu de Hamburgo. Anais dos Serviços de Veterinária de Moçambique 7: 229–235. [In Spanish]

Sapegina VF (1980) Distribution of Ixodoidea ticks in the forest zone of Western and Central Siberia (*Ixodes persulcatus*, *Ixodes trianguliceps*, *Ixodes apronophorus*). Trudy AN SSSR, Sibirskoe otdelenie, Biologicheskii institut 67: 76. [In Russian]

Sapegina VF, Ravkin YS (1969) About findings of *Ixodes pavlovskyi* Pom. in the North-Eastern Altai. Parazitologiia 3(1): 22–23. [In Russian]

Sarsenbaeva BT, Kazangapov KZ, Uzenbekov ShB, Kopkova AI, Shonshabaeva DT, Kusepbaeva JO, Nurbaev KT (2016) Fauna of mammals and their ectoparasites of the Talas and Kyrgyz Alatau of the Jambul region. Zhurnal (3): 50. [In Russian]

Sato M, Ikeda S, Arai R, Kato M, Aoki J, Nishida A, Watanabe K, Hirokawa C, Watanabe K, Regilme MAF, Sato M, Sato MO, Tamura T (2021) Diversity and distribution of ticks in Niigata prefecture, Japan (2016–2018): Changes since 1950. Ticks and Tick-Borne Diseases 12(3): 101683. https://doi.org/10.1016/j.ttbdis.2021.101683

Savitskaya GM (1975) On the distribution of *Ceratixodes putus* Pick. - Cambr., 1878 (Ixodidae) on the continental seacoast of the Far East. Vestnik Zoologii 2: 85–86. [In Russian]

Savitsky BP, Okuntsova EF (1967) On the distribution of *Ixodes angustus* Neum. (Ixodidae). Zoologicheskij Zhurnal 46(12): 1849–1850. [In Russian]

Scherbinina OCh (1973) To the fauna of Ixodoidea of birds of Turkmenistan. In: Parasites of Animals of Turkmenistan. Ylym, Ashgabat, Turkmenistan, 62–78. [In Russian]

Schipanov NA, Makhanko EV (2018) Notes on feeding of ixodid tick larvae and nymphs on shrews of the genus *Sorex* (Lipotyphla) in the south-east of the Tver region. Zoologicheskij Zhurnal 97(2): 190–195. https://doi.org/10.7868/S0044513418020071 [In Russian]

Schluger IS (1961) Some data on the biology of *Ixodes trianguliceps* Bir. and *I. persulcatus* P. Sch. in the Krasnoyarsk Territory. Medicinskaja Parazitologiya I Parazitarnye Bolezni 30(4): 425–433. [In Russian]

Schulze P (1924) *Ixodes apronophorus* n. sp.: Eine neue deutshce Zecke von Arvicola amphibius. Zoologischer Anzeiger 59: 281–284. [In German]

Schulze P (1930) Über einige Verwandte von *Ixodes ricinus* L. aus Ostasien. Zoologischer Anzeiger 90: 294–303. [In German]

Schulze P (1932) Die Zecken als Vogelparasiten. Journal für Ornithologie 80: 318–329. https://doi.org/10.1007/BF01905401 [In German]

Schulze P (1935) Zur vergleichenden Anatomie der Zecken. Zeitschrift für Morphologie und Ökologie der Tiere 30: 1–40. [In German]

Schulze P (1938) Über rein glabellare Karapaxbildungen bei Milben und über die Umgestaltung des Vorderkörpers der Ixodoidea als Folge der Gnathosomaentstehung. Zoomorphology 34(1): 135–149. https://doi.org/10.1007/BF00408215 [In German]

Schulze P (1939) Zur Zeckenfauna Burmas. Parasitology Research 10(6): 722–728. https://doi.org/10.1007/BF02122034 [In German]

Schulze P (1941) Das Geruchsorgan der Zecken. Untersuchungen über die Abwandlungen eines Sinnesorgans und seine stammesgeschichtliche Bedeutung. Zeitschrift Für Morphologie Und Ökologie Der Tiere 37(3): 491–564. https://doi.org/10.1007/BF00408327 [In German]

Schulze P (1942) Die morphologische Bedeutung des Afters und seiner Umgebung bei den Zecken. Zeitschrift für Morphologie und Ökologie der Tiere 38(3): 630–658. https://doi.org/10.1007/BF02309884 [In German]

Schulze P, Schlottke E (1929) Kleinhöhlenbewohnende deutsche Zecken mit Beschreibung dreier neuer Baumhöhlenbrüter und einer Bestimmungstabelle der deutschen *Ixodes*. Sitzungsberichte und Abhandlungen der Naturforschenden Gesellschaft zu Rostock 2(1927–1929): 95–112. [In German]

Serdjukova GV (1941) Relict species *Ixodes pomerantzevi* sp. n. DAN SSSR 32(7): 519–522. [In Russian]

Serdjukova GV (1956) Ixodid ticks of the fauna of USSR (Vol. 64.). Keys to the fauna of the USSR published by the Zoological Institute of the Academy of Sciences of the USSR, 122 pp. [In Russian]

Shadrina EG, Nikiforov OI, Ivanova MG (2011) Population dynamics and distribution of ticks (Ixodidae) in Yakutia. Uspekhi Sovremennoi Biologii 131(5): 469–473. [In Russian]

Shaposhnikova LI, Sakhno NV (2012) To the study of the fauna of ixodid ticks of the Republic of Abkhazia. Infekcija I Immunitet 2(1–2): 213–213. [In Russian]

Shatas YF (1957) Ticks Ixodoidea and fleas of Dagestan. Scientific conference on natural foci and epidemiology of especially dangerous infectious diseases. Tezisy Dokladov. Saratov, 433–437. [In Russian]

Shevchenko ZG, Timofeev MA, Strikanova EV, Ushmarova NN, Yarov TV, Petrova LR (1960) Ixodid ticks – carriers and vectors of tularemia in Krasnodar Krai. Trudy Rostov-Na-Donu Gosudarstvennogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta 17: 166–172. [In Russian]

Shilova SA, Clabovskii VI (1968) The species composition of vertebrate animal hosts of *Ixodes persulcatus* P. Sch. within the distribution area of this species. Bulleten' MOIP. Otdelenie Biologii 65(5): 40–51. [In Russian]

Shtilmark FR (1963) Zoological and parasitological materials for the study of natural foci of infections in the forests of the Western Sayan. Uchenye Zapiski Krasnoyarskogo Gosudarstvennogo Pedagogicheskogo Instituta 24(5): 44–69. [In Russian]

Sirotkin MB, Korenberg EI (2018) Influence of abiotic factors on different developmental stages of the taiga (*Ixodes persulcatus*) and European forest (*Ixodes ricinus*) ticks. Zoologicheskij Zhurnal 97(4): 379–396. https://doi.org/10.7868/S0044513418040013 [In Russian]

Siuda K, Stanko M, Piksa K, Górz A (2009) Ticks (Acari: Ixodida) parasitizing bats in Poland and Slovakia. Wiadomosci Parazytologiczne 55(1): 39–45.

Sklyar VE (1970) On the fauna of ixodid ticks from southern Donetsk District. Parazitologiia 4(6): 524–527. [In Russian]

Skrynnik AP (1950) About bloodsucking arthropods of southern Sakhalin. Entomologicheskoe Obozrenie 31(1–2): 109–112. [In Russian]

Slonov MN (1961) To the study of the tick *Ixodes pomeranzevi* G. Serd. 1941 in Southern Primorye. Medicinskaja Parazitologiya I Parazitarnye Bolezni 30(5): 622–623. [In Russian]

Smith RP, Muzaffar SB, Lavers J, Lacombe EH, Cahill BK, Lubelczyk CB, Kinsler A, Mathers AJ, Rand PW (2006) *Borrelia garinii* in seabird ticks (*Ixodes uriae*), Atlantic Coast, North America. Emerging Infectious Diseases 12(12): 1909–1912. https://doi.org/10.3201/eid1212.060448

Solovyov YK (1966) To the knowledge of the fauna and ecology of ixodid ticks of the Gorky Oblast. Uchenye Zapiski Gor'kovskogo Universiteta 75: 106–116. [In Russian]

Sonenshine DE, Kohls GM, Clifford CM (1969) *Ixodes crenulatus* Koch, 1844 synonymy with *I. kaiseri* Arthur, 1957 and redescriptions of the male, female, nymph, and larva (Acarina: Ixodidae). Acarologia 11(2): 193–206.

Sorokoumov GI (1937) Ticks of the superfamily Ixodoidea of Jarkent District. Trudy Kazahskogo Filiala AN SSSR 2: 85–95. [In Russian]

Sosnina EF (1954) On the tick *Ixodes trianguliceps* Bir. in Tajikistan. Trudy AN TajSSR 21: 65–69. [In Russian]

Sosnina EF (1957) Parasites of murine rodents of the Hisar Valley and the southern slopes of the Hisar Range (Tajikistan). Trudy Instituta Zoologii AN TajSSR 64: 1–165. [In Russian]

Speranskaya VN (1958) Ectoparasite fauna of some rodent species of the southeastern coast of the Kamchatka Peninsula. Trudy Voenno-Medicinskoj Ordena Lenina Akademii Imeni Kirova 81: 110–114. [In Russian]

Stakheev VV, Panasyuk NV (2016) Structure of parasite fauna of temporal ectoparasites of West-Palearctic wood mice of Rostov region. In: Modern Problems of Vertebrate Zoology and Parasitology: Materials of the VIII International Correspondence Scientific Conference "Readings in memory of Professor I.I. Barabash-Nikiforova" Voronezh, 200–206. [In Russian]

Stanyukovich MK, Fedorov DD (2022) Ectoparasites (Acari: Gamasina, Ixodidae; Insecta: Anoplura) of small mammals of the Cape Kartesh (BBS Zin Ras, Karelia, Louch District). Parazitologiia 56(3): 252–264. [In Russian]

Starikov VP, Starikova TM (2021) Species composition and distribution of ixodid ticks (Parasitiformes, Ixodidae) in the Kurgan oblast. Vestnik Severo-Vostochnogo Federal'nogo Universiteta Im. M. K. Ammosova 1(81): 20–33. https://doi.org/10.25587/b9109-8666-3535-u [In Russian]

Starikov VP, Mayorova AD, Bernikov KA, Sarapultseva ES (2017a) Small mammals and their ectoparasites (Ixodidae) of the floodplain of the middle Ob and cross-border regions. Vestnik Surgutskogo Gosudarstvennogo Universiteta 4(18): 58–66. [In Russian]

Starikov VP, Mayorova AD, Sarapultseva ES, Bernikov KA, Nakonechny NV, Morozkina AV, Borodin AV, Petukhov VA (2017b) Materials on *Ixodes* tick (Ixodidae) of the Khanty-Mansi Autonomous Okrug–Yugra. Samarskij Nauchnyj Vestnik 6(2): 88–91. https://doi.org/10.17816/snv201762117 [In Russian]

Subbotina IA, Osmolovsky AA (2022) Climatic features of parasitation and the prevalence of ixodid ticks in various territories of Viciebsk and Viciebsk District. Agrarnyj Vestnik Verhnevolzh'ja 3(40): 72–84. [In Russian]

Sukhiashvili R, Zhgenti E, Khmaladze E, Burjanadze I, Imnadze P, Jiang J, St. John H, Farris ChM, Gallagher T, Obiso RJ, Richards AL (2020) Identification and distribution of nine tick-borne spotted fever group rickettsiae in the country of Georgia. Ticks and Tick-Borne Diseases 11(5): 101470. https://doi.org/10.1016/j.ttbdis.2020.101470

Sukhomlinova OI (1977) Ecology of ixodid ticks from small mammals in the Leningrad Oblast. Parazitologiia 11(5): 436–441. [In Russian]

Tagiltsev AA, Tarasevich LN, Bogdanov II, Rossolov MA, Yakimenko VV (1984) Tree sparrows and their arthropod nidicols in natural nidi of viral infections. Parazitologiia 18(1): 89–95. [In Russian]

Takahashi M, Chunikhin SP (1972) Species composition and population of ixodid ticks in forest biotopes in the northern regions of Japan. Current Problems of Virology and Prevention of Viral Diseases, 572–573.

Tanitovsky VA, Maikanov NS (2018) Fauna of Ixodid ticks of West Kazakhstan and features of their distribution across the territory. BҚMU Habarshysy 2(70): 294–305. [In Russian]

Tarasevich LN, Tagil'tdev AA, Mal'kov GB (1971) Reisolation of tick-borne encephalitis virus from *Ixodes crenulatus* Koch ticks in southern Omsk Oblast. Abstracts of reports: Voprosy Medicinskoj Virusologii. Ivanovskij Institut Virusologii AMN SSSR 2: 134–135. [In Russian]

Ter-Vartanov VN, Gusev VM, Reznik PA, Guseva AA, Mirzoeva MN, Bocharnikov ON, Bakeev NN (1956) On the issue of the transfer of ticks and fleas by birds. Communication II. Zoologicheskij Zhurnal 35(2): 173–189. [In Russian]

Tiflova LA (1974) Experimental study of *Ixodes redikorzevi redikorzevi* Ol., 1927, as carriers of tularaemia. Medicinskaja Parazitologiya I Parazitarnye Bolezni 6: 719–723. [In Russian]

Tiflova LA, Reznik PA, Ionova EV (1970) Ixodid ticks of Stavropol Krai and their medical significance. In: Vectors of particularly dangerous infections and their control. Stavropolskaya Pravda, Stavropol, Russia, 459–471. [In Russian]

Timofeeva AA, Kon'kova KV (1971) Distribution and ecology of ixodid ticks in Sakhalin and the Kuril Islands. Voprosy geographii Dal'nego Vostoka 9: 327–338. [In Russian]

Timofeeva AA, Lvov DK, Chupakhina TI, Lebedev VI, Pogrebenko AG (1971) On ixodid ticks of sea colonial birds on Tyuleniy Island adjacent to Sakhalin and the Kuril Archipelago. In: Proceedings of the 4th Symposium on the Study of Viruses Ecologically Related to Birds. Omsk, Siberia, 36–37. [In Russian]

Timofeeva AA, Pogrebenko AG, Gromashevsky VL, Scherbinin RD, et al. (1974) Foci of natural infections on the island of Iona in the Sea of Okhotsk. Zoologicheskij Zhurnal 53(6): 909–911. [In Russian]

Tkachev SE, Tikunov AY, Babkin IV, Livanova NN, Livanov SG, Panov VV, Yakimenko VV, Tantsev AK, Taranenko DE, Tikunova NV (2017) Occurrence and genetic variability of Kemerovo virus in *Ixodes* ticks from different regions of Western Siberia, Russia and Kazakhstan. Infection, Genetics and Evolution 47: 56–63. https://doi.org/10.1016/j.meegid.2016.11.007

Tokarsky VA, Zorya AV (2007) Epizootological significance of the steppe marmot (*Marmota bobak bobak* Müll., 1776). Visnik Harkivs'kogo nacional'nogo universitetu imeni VN Karazina. Serija: Biologija 5: 112–115. [In Russian]

Tretyakov K (2009) Small mammals and their parasites (ixodid ticks) in urban forests and parks of St. Petersburg. Estonian Journal of Ecology 58(3): 232–239. https://doi.org/10.3176/eco.2009.3.08

Tsapko NV (2017) Tick *Ixodes kaiseri* (Acari, Ixodidae) in the North Caucasus and Transcaucasia according to the material from the collection of the Stavropol Anti-Plague Institute. Parazitologiia 51(6): 528–533. [In Russian]

Tsapko NV (2019) The tick (Acari, Ixodidae) fauna of the Stavropol region and the role of different species in transmission of natural focus infection. Medicinskaja Parazitologiya I Parazitarnye Bolezni 4: 17–25. https://doi.org/10.33092/0025-8326mp2019.4.17-33 [In Russian]

Tsapko NV (2020) A checklist of the ticks (Acari: Ixodidae) of Russia. Parazitologiya 54(4): 341–352. https://doi.org/10.31857/S1234567806040069 [In Russian]

Tsapko NV (2023) The role of corvids in the feeding of ixodid ticks (Acarina, Ixodidae) in the North Caucasus. Russkij Ornithologiceskij Zurnal 32(2263): 156–160. [In Russian]

Tsapko NV, Kotti BK (2017) The tick *Ixodes frontalis* (Acari, Ixodidae) in the North Caucasus. Parazitologiia 51(3): 253–260. [In Russian]

Tsvirko LS (2008) National parks of Belarusian Polesie: Problems of epidemic safety. Vestnik Polesskogo Gosudarstvennogo Universiteta. Serija Prirodovedcheskih Nauk 2: 13–18. [In Russian]

Turtseva MA (2007) Fauna of ixodid ticks in the Saratov region under the present conditions. Medicinskaja Parazitologiya I Parazitarnye Bolezni 3: 46–48. [In Russian]

Ushakova GV (1958) Ixodid ticks parasitizing birds in the lower reaches of the Ili River. Trudy Instituta Zoologii AN KazSSR 9: 135–145. [In Russian]

Ushakova GV (1960). Ecological and faunistic review of ixodid ticks in the lower reaches of the Ili River. In: Parasites of animals of Kazakhstan. Izdatel'stvo AN KazSSR. Alma-Ata, Kazahstan, 148–161. [In Russian]

Ushakova GV (1961) To the fauna of ixodid ticks of the Betpak-Dala desert. In: Natural foci of diseases and issues of parasitology, 3. Izdatel'stvo AN KazSSR. Alma-Ata, Kazahstan, 474–476. [In Russian]

Ushakova GV (1962) Materials on ixodid ticks in the Tselinograd region. Trudy Instituta Zoologii AN KazSSR 16: 177–182. [In Russian]

Ushakova GV, Fedosenko AK (1963) On the occurrence of ticks *Ixodes stromi* Fil. 1957 at the Zaili Alatau. Trudy Instituta Zoologii AN KazSSR 19: 240–241. [In Russian]

Ushakova GV, Fedosenko AK (1972) Ixodid ticks of the Trans-Ili Alatau. Trudy Instituta Zoologii AN KazSSR 33: 130–138.

Ushakova GV, Filippova NA (1968) On the species of the group of *Ixodes persulcatus* (Parasitiformes, Ixodidae) On the ecology of *I. pavlovskyi* Pom. from East Kazakhstan. Parazitologiia 2(4): 334–338. [In Russian]

Ushakova GV, Fedosenko AK, Lobachev YS (1976) Ixodid ticks of the Dzungarian Alatau (Parasitiformes, Ixodidae). Trudy Instituta Zoologii AN KazSSR 36: 100–111. [In Russian]

Uspenskaya IG (1987) Ixodid ticks of the Dniester-Prut interfluve. Shtiintsa, Chișinău, Moldova, 144 pp. [In Russian]

Uspenskaya IG, Konovalov IN, Rozenfel'd BD, Untura AA (1984) Changes of the ecological situation in the focus of increased number of ticks *Ixodes apronophorus* Schulze in the southern part of the Prut River area caused by anthropogenic factors. In: Abstracts of the Academy of Sciences of the Moldovan SSR (Series of biological and Chemical Sciences). Shtiintsa, Chișinău, Moldova, 29–34. [In Russian]

Uspenskaya IG, Georgita SD, Movile AA, Burlaku VI, Gutsu AG, Konovalov YN, Melnik VN, Kulbachnaya EW (2006) Structure and dynamics of the faunistic complex of mam-

mals and ixodid ticks in various landscape-faunistic zones of the territory of Moldova, their epizootological significance. Collection of Scientific Articles 130: 153.

Uspensky IV (1993) Ability of successful attack in two species of ixodid ticks (Acari: Ixodidae) as a manifestation of their aggressiveness. Experimental & Applied Acarology 17(9): 673–683. https://doi.org/10.1007/BF00058507

Uspensky IV (2017) Blood-sucking ticks (Acarina, Ixodoidea) as an essential component of the urban environment. Entomological Review 97(7): 941–969. https://doi.org/10.1134/S0013873817070107

Uspensky IV (2021) The Eldari tick *Ixodes eldaricus* (Acari: Ixodidae) in Israel: its occurrence, morphometric and biological characteristics. Acarological Studies 3(1): 9–15. https://doi.org/10.47121/acarolstud.844856

Uzakov WY (1972) Ixodid ticks of Uzbekistan. Fan, Tashkent, Uzbekistan, 304 pp. [In Russian]

Vershinina TA (1988) *Ixodes trianguliceps* (Parasitiformes, Ixodidae) in the southern Lake Baikal area. Parazitologiia 22(4): 329–336. [In Russian]

Violovich NA (1958) To the fauna of ixodid ticks of Sakhalin and the Kuril Islands. Izvestiya Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta Sibiri I Dal'nego Vostoka 17: 205–208. [In Russian]

Violovich NA (1960) Materials on the fauna of ectoparasites of the brown rat of Sakhalin and the Kuril Islands. Izvestiya Irkutskogo Nauchno-Issledovatel'skogo Protivochumnogo Instituta Sibiri I Dal'nego Vostoka 22: 250–256. [In Russian]

Violovich NA (1962a) To biology of *Ixodes signatus* Birula on the islands of the Far East. In: Problems of zoological research in Siberia. Gorno-Altaiskoje Knizhnoje Izdatel'stvo, Gorno-Altaisk, 37–39. [In Russian]

Violovich NA (1962b) To the ecology of *Ceratixodes putus* Pick-Camb., 1878 (Ixodidae) on the islands of the Far East. In: Questions of ecology (Vol. 8.). Edition of Kyiv University, Kyiv, Ukraine, 20–21.

Volkov VI, Chernykh PA (1977) Discovery of *Ixodes lividus* (Ixodidae) in the Amur area. Parazitologiia 11(3): 264–265.

Voltsyt OV (1997) New faunistic records of ixodid ticks from eastern regions of Russia based in collections of the Zoological Museum of Moscow State University. Description of the nymph *Ixodes* (*Monoindex*) *maslovi*. Parazitologiia 31(3): 265–268. [In Russian]

Wang SS, Liu JY, Wang BY, Wang WJ, Cui XM, Jiang JF, Sun Y, Wen-Bin G, Yu-Sheng P, Zhou YH, Zhe-Tao L, Jiang BG, Zhao L, Cao WC (2023) Geographical distribution of *Ixodes persulcatus* and associated pathogens: Analysis of integrated data from a China field survey and global published data. One Health 16: 100508. https://doi.org/10.1016/j.onehlt.2023.100508

Warburton C (1927) On five new species of ticks (Arachnida, Ixodoidea), *Ornithodorus nattereri*, *Ixodes theodori*, *Haemaphysalis toxopei*, *Amblyomma robinsoni* and *A. dammermani*, with a note on the ornate nymph of *A. latum*. Parasitology 19(4): 405–410. https://doi.org/10.1017/S0031182000005886

Wilson N (1967) Mesostigmata: Rhinonyssidae, Halarachnidae (nasal mites); Metastigmata: Ixodidae (ticks). In: Gressitt L (Ed.) Entomology of Antarctica. 10: 41–49. https://doi.org/10.1029/AR010p0041

Woo IC, Baba S, Suzuki H, Kawabata M (1990) A case of tick bite with *Ixodes turdus* Nakatsuji. The Journal of Dermatology 17(1): 56–58. https://doi.org/10.1111/j.1346-8138.1990.tb01610.x

Yakimenko VV, Bogdanov II, Tagil'tsev AA, Drokin DA, Kalmin OB (1991) The characteristics of the relationships of arthropods of the refuge complex with the causative

agents of transmissible viral infections in bird rookeries. Parazitologiia 25(2): 156–162. [In Russian]

Yakimenko VV, Malkova MG, Shpynov SN (2013) Ixodid ticks of Western Siberia. OOO Izdatel'skij centr "Omskij nauchnyj vestnik", Omsk, 240 pp. [In Russian]

Yamaguti N, Tipton VJ, Keegan HL, Toshioka S (1971) Ticks of Japan, Korea and the Ryukyu Islands. Brigham Young University Science Bulletin 15(1): 1–225. https://doi.org/10.5962/bhl.part.25691

Yamborko AV, Eremeeva YV (2014) Detection of *Anaplasma phagocytophilum* in *Ixodes angustus* ticks found in the Magadan Region. Problemy Osobo Opasnyh Infekcij 4: 83–84. https://doi.org/10.21055/0370-1069-2014-4-83-84 [In Russian]

Yamborko AV, Tretyakov KA, Muravyova VP (2015) The first findings of *Ixodes persulcatus* (Acarina, Ixodidae) in Magadan Province. Entomological Review 95(5): 666–671. https://doi.org/10.1134/S0013873815050103

Yasyukevich VV, Kazakova EV, Popov IO, Semenov SM (2009) Distribution of *Ixodes ricinus* L., 1758 and *Ixodes persulcatus* Shulze, 1930 (Parasitiformes, Ixodidae) in Russia and adjacent countries in view of observable climate changes. Doklady Earth Sciences 427(2): 1030–1034. https://doi.org/10.1134/S1028334X09060312

Yin X, Ye Z, Jiao WA, Ma D, Zhang J, Zha Y (2010) Tick fauna and monitoring of tick host animals at Alataw Pass. Zhongguo Meijie Shengwuxue Ji Kongzhi Zazhi 21(4): 375–377.

Zaytsev AA, Popova EV (1967) On the spread of ticks *Ixodes redikorzevi redikorzevi* Ol. in Stavropol region. Medicinskaja Parazitologiya I Parazitarnye Bolezni 36(4): 492–493. [In Russian]

Zaytseva OA, Gnusareva OA, Vasil'eva OV, Volynkina AS, Siritsa YV, Alekhina YA, Chishenyuk TI, Gazieva AY, Ashibokov UM, Davydova NA, Lazarenko EV, Ermolova NV, Kulichenko AN (2022) Results of epizootiological monitoring of natural foci for bacterial vector-borne infections in the Caucasian Mineral Waters Region of the Stavropol Territory in 2018–2020. Problemy Osobo Opasnyh Infekcij 1: 101–105. https://doi.org/10.21055/0370-1069-2022-1-101-105 [In Russian]

Zhao S, Yang M, Jiang M, Yan B, Zhao S, Yuan W, Wang B, Hornok S, Wang Y (2019) *Rickettsia raoultii* and *Rickettsia sibirica* in ticks from the long-tailed ground squirrel near the China–Kazakhstan border. Experimental & Applied Acarology 77(3): 425–433. https://doi.org/10.1007/s10493-019-00349-5

Zilfyan VN, Avetisyan GA, Ovasonyan OV (1960) On the fauna of bird ticks in Armenia. Trudy Armyanskoj Protivochumnoj Stancii 1: 463–476. [In Russian]

Zimina YV, Birulya NB, Berezin VV (1965) Materials of zoological and parasitological characteristics of Crimean hemorrhagic fever in the Astrakhan region. Trudy Instituta Poliomyelita I Virusnogo Encephalita 7: 288–395. [In Russian]

Zimina YV, Kulikova LN, Salko VN, Kovtunov AI (1996) Ixodid ticks of the Astrakhan region, their role in the formation of natural foci and the transmission of arboviruses to humans. In: Issues of Rickettsiology and Virology (Collection of Scientific Papers). Astrakhan'-Moskva, 58–62. [In Russian]

Zolotov PE, Buker VP (1976) Life cycle of *Ixodes lividus* Koch under the conditions in Leningrad Province. Parazitologiia 10(4): 376–378. [In Russian]

Zumpt F (1952) The ticks of sea birds. Australian National Antarctic Research Expedition Reports, Series B. Zoology: Analysis of Complex Systems, ZACS 1: 12–20.